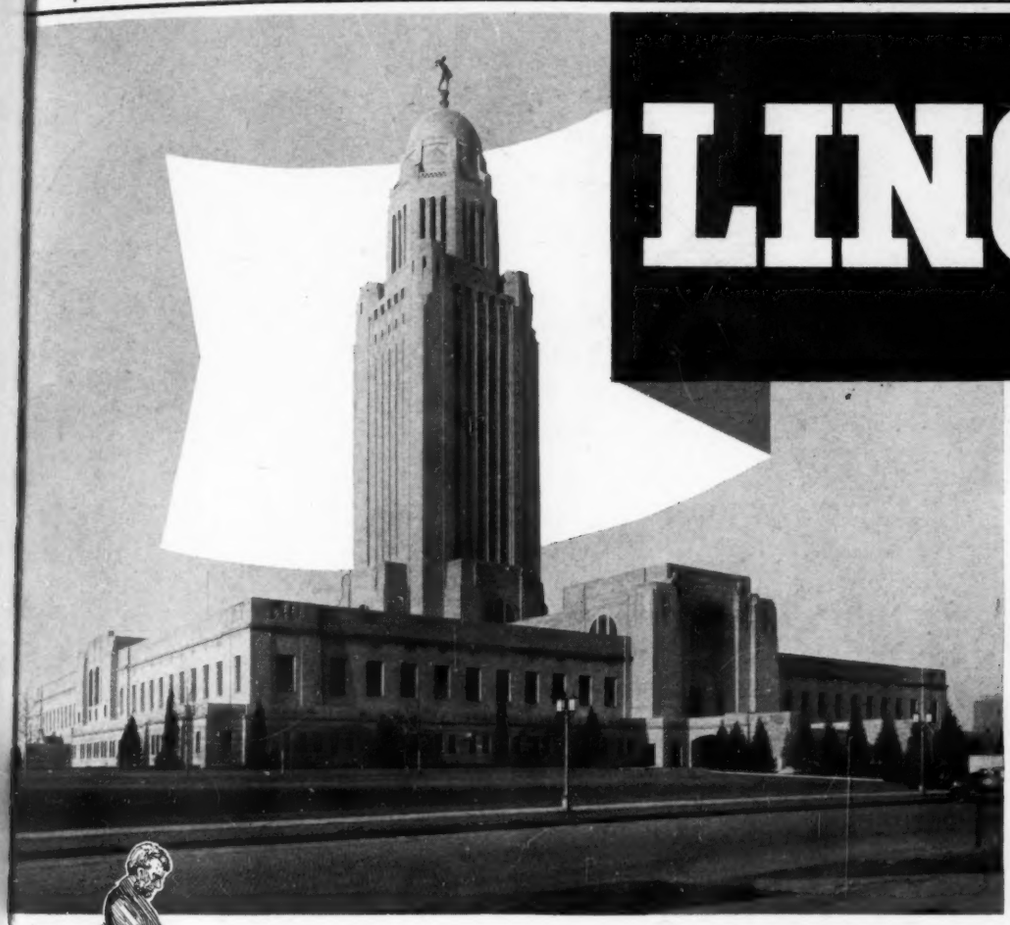
WATER WORKS & SEWERAGE

April, 1936 — Volume 83. No. 4



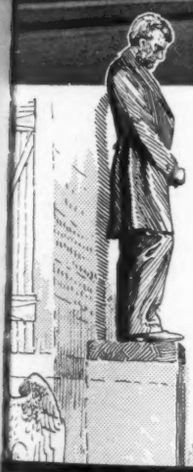
LINCOLN

All of the central activities of a vast agricultural commonwealth; the world-famed Nebraska Capitol building, the most original conception of American art with particular historical application and expression of the purpose and ideals of the Nebraska region; the State University; the Agricultural College and three denominational colleges are located in the beautiful setting of this boulevarded city, nearing a hundred thousand population. A city worthy of a noble name and the capital of Nebraska, Lincoln has been created as the Service City of the state with a life at once simple, charming and refined—typical of Nebraska at her best. It is located in the southeast-central part of Nebraska—approximately the center of the state's population.

Lincoln, with an agricultural background, is important as a cultural, professional and distributing center; the benefits accruing from these activities offer unique industrial opportunities. The industries located here produce a wide diversification of products. It has a well established financial background with strong and accommodating banking facilities.

During the summer of 1932, Lincoln's new water pumping plant at Ashland was put into operation. This provides an unlimited supply of palatable and safe water for Lincoln. The keen foresightedness of the City Officials in adopting a 100% metered system has enabled the City to maintain the very reasonable rate that has been in effect for the last thirty years.

We are proud of the fact that Pittsburgh Water Meters have contributed towards making such a record possible.



STATE CAPITOL BUILDING AT LINCOLN, NEBRASKA

PITTSBURGH EQUITABLE METER CO.
MERCO NORDSTROM VALVE CO.
MAIN OFFICES PITTSBURGH, PA.

NEW YORK · LOS ANGELES · TULSA · HOUSTON · MEMPHIS · BUFFALO
COLUMBIA · KANSAS CITY · CHICAGO · PHILADELPHIA · ATLANTA · OAKLAND

PITTSBURGH WATER METERS

ABC

DESIGN · CONSTRUCTION · COLLECTION
TREATMENT · DISTRIBUTION · DISPOSAL

ABP

IN OUR MODERN FOUNDRIES metallurgical and production control are well-nigh infallible. No other conclusion could be reached by the pipe user who will spend a day in our headquarters research laboratory. Or watch our newest Super-de Lavaud centrifugal unit casting gray iron without chill in a metal mold. The significant progress in cast iron pressure pipe manufacture in 270 years has been in *uniformity* of quality. Far more significant is the fact that without these modern advantages foundry men more than two centuries ago cast good gray iron into pipe which is still in service.

SUPER-DE LAVAUD CENTRIFUGAL CAST IRON PIPE

U. S. Pit Cast Pipe — *U. S. Threaded Cast Iron Pipe*
U. S. Mechanical Joint Pipe — *U. S. Ni-Resist Cast Iron Pipe*
U. S. Flexible Joint Pipe — *U. S. Cast Iron Culverts*
Alloy and Gray Iron Castings — *U. S. Cast Iron Roof Plates*

U.S. cast iron PIPE

Cast iron and alloy cast iron pipe centrifugally or pit cast—for water works, gas, sewerage and drainage service as well as industrial uses involving corrosives.

U. S. PIPE & FOUNDRY CO.
BURLINGTON, NEW JERSEY
Foundries and Sales Offices throughout the U. S.

WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"Emptying Water Mains With Compressed Air"—Roger W. Esty and Nelson Boardman, Sup't and Ass't Sup't of the Danvers (Mass.) Water Department, will describe a very practical method of emptying water mains which was developed in Danvers and has proved effective in precluding or minimizing ditch pumping when cutting a line for repairs. This article is one of several to be contributed by water works operators during the year in a "Practical Operating Kink" series.

"Garbage Disposal via Sewage Treatment" is a subject of considerable current interest, and justifiably so. C. K. Calvert, Engr.-Manager, Waste Disposal Plants, Indianapolis, and S. L. Tolman, Manager Sanitary Division, Jeffrey Manufacturing Co., Columbus, O., in a joint paper, will reveal results of a plant scale demonstration and careful study made at the Indianapolis activated-sludge plant, wherein the city's garbage was shredded and put through the plant in increasing quantities during the past summer.

"Secondary Elements for Water Works and Sewerage Meters" constitutes a discussion of the fundamentals of various types of flow-indicating and recording registers with notes on their installation. From L. D. Carlyon, Engr., Bailey Meter Co., this article has been secured in answer to suggestions from readers impressed with his earlier article (November, 1935) dealing with "Primary Elements for Water Works and Sewerage Meters."

"Comparative Costs of Iron Salts for Water, Sewage or Sludge Treatment"—Has been prepared by Wm. H. Baumgartner, Chemical Engr., Grasselli Chemical Co., at the specific request of "Water Works and Sewerage." His article will serve as a useful guide in the hands of engineers, chemists and others called upon to evaluate and make selections from the ferric-salts now available for treatment and sludge filtration. The analysis reveals their comparative efficacy as to coagulating values and their base cost in terms of available iron content. Included in the evaluation is the combination of ferrous-sulphate and chlorine to produce "chlorinated-copperas" at the point of usage.

"Fire Hydrants, Their Installation and Maintenance"—E. H. Ruehl, former Superintendent of Utilities, then a City Manager, and now a Field Consultant, has prepared this article as a result of his observations revealing a too prevalent laxity in maintenance of hydrants. He sets forth a proposed minimum schedule to be followed by even the smallest utility in routine hydrant inspection and maintenance. Our problem is how to get Mr. Ruehl's suggestions to those who need them most. Many will not see his article, because they read little—do less.

"Sewerage Kinks"—by A. M. Rawn, Ass't Chief Engr., Los Angeles County Sanitation Districts and President of the California Sewage Works Association, constitutes a follow-up article to his previous contribution "Sewer Cleaning with Rubber Beach Balls" which appeared in WATER WORKS and SEWERAGE for October, 1935.

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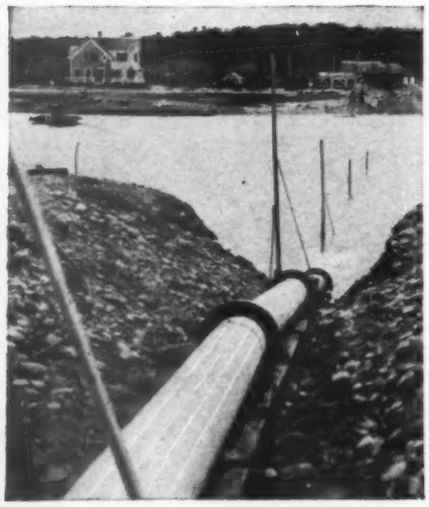
Here's the INSIDE STORY on Low Pumping Costs!

Constant C-140 is responsible for Permanent Savings on this Non-Tuberculating Pipe...



There's an "Outside" Story, too!

Scituate, Mass. installed Transite in 1932 to pipe water through salt marsh and river. Proving exceptionally resistant to corrosion, they have since used it on three more projects.

ISN'T THIS TRUE?

Since water pipe is laid solely for the purpose of carrying water, in the last analysis your investment is not in pipe but in water transportation facilities.

Why, then, in figuring the cost of a new main, should the yardstick be cost per foot of pipe? Isn't it much more logical to evaluate a water main primarily on its effectiveness as a water carrier?

And not solely on its effectiveness when new . . . all too often water mains are at the mercy of tuberculation, which constantly decreases the delivery capacity of ordinary pipe.

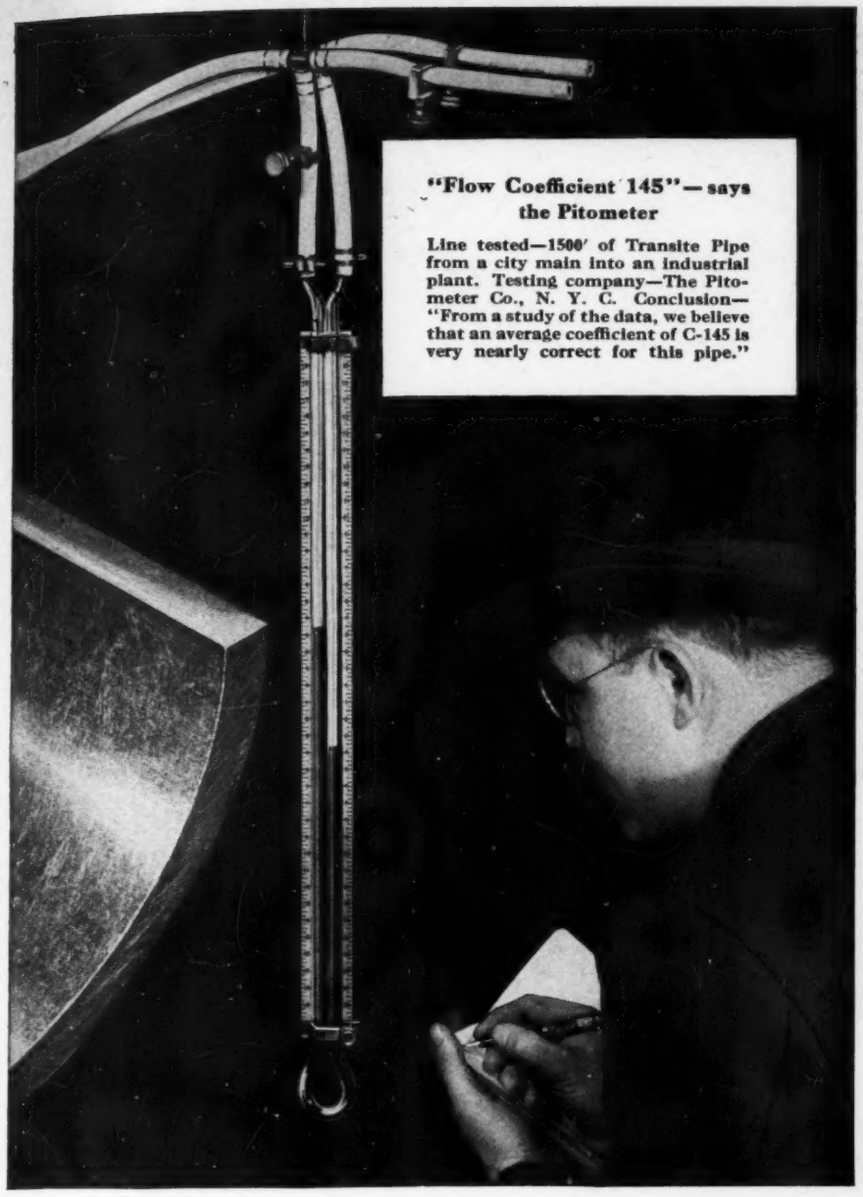
Can you afford, therefore, to pass up the savings in pumping costs offered by Transite Pipe . . . as already proved by hundreds of installations?

C-140 is the conservative minimum coefficient of Transite . . . not merely when first laid . . . not merely after five years or ten . . . but indefinitely.

Made of asbestos and cement . . . and hence non-metallic . . . it is physically impossible for Transite Pipe to tuberculate. From the day

JM PRODUCTS

Johns-Manville

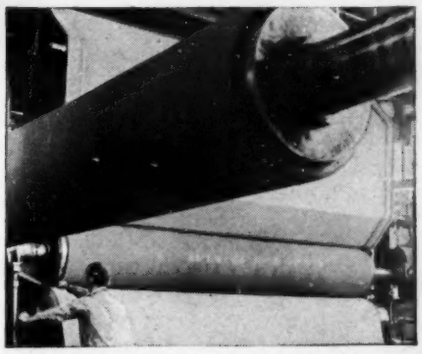


"Flow Coefficient 145"—says the Pitometer

Line tested—1500′ of Transite Pipe from a city main into an industrial plant. Testing company—The Pitometer Co., N. Y. C. Conclusion—"From a study of the data, we believe that an average coefficient of C-145 is very nearly correct for this pipe."

ENDING TUBERCULATION. In relatively few years tuberculation had seriously reduced the capacity of water lines at Belmont, Mass. Hence, for their recent Cushing Ave., project, they specified Transite, the *non-tuberculating* pipe.

INSTALLATION SAVINGS. A 16" line—an unusually deep trench; but lightweight Transite was laid down quickly, economically, without mechanical equipment. (W. Warwick, R. I.)



CLOSE-UP of one of the huge machines on which Transite Pipe is formed, under high pressure, into a dense, homogeneous structure, remarkably resistant to destructive agencies.

it comes off the polished steel mandrel that forms its smooth interior wall, this pipe's all-important value of C remains unchanged. High to start, its immunity to tuberculation keeps that coefficient high. And thus keeps pumping costs permanently low.

How Great are these Savings? The answer lies in a comparison of Transite's constant coefficient with one that drops steadily, due to tuberculation. Actually, in overcoming friction head, it costs only about half as much to pump against a coefficient of C-140 as against one of C-100. Project that over a period of years and you'll see the significance of our statements *on permanent savings.*

Do You Want All the Facts? An interesting series of hydraulic tables covers all the facts on this very important relationship between friction resistance and pumping costs. Based on the Hazen and Williams Hydraulic Tables, they establish the power needed to overcome loss of head due to friction in different sizes of pipe, carrying varying quantities of water, and with values of C from 60 to 140.

Send for these tables today . . . and also for a copy of the Transite Pipe brochure. Read the complete story of Transite's important installation and maintenance savings, as well as low pumping costs.

TRANSITE PRESSURE PIPE

An ASBESTOS Product

JOHNS-MANVILLE
22 East 40th St., New York City
Send me the Transite Pipe Brochure and Hydraulic Tables.

Name_____ **Title**_____

Organization_____

Address_____

City_____ **State**_____

WWS-4-36

TALK ABOUT TROUBLE

If you think this young lady is in trouble—just wait until these same winds and rains wash tastes and odors down into your plant.

This time of year it is good practice to use Nuchar all of the time—because tastes and odors come with every run off. March winds and April showers bring many things—as you know—AMONG THEM TASTES AND ODORS.

"Are you making your plans now to attend the National Meeting of the American Water Works Association, Los Angeles, Calif., June 8th to 12th? Many interesting papers are to be read and you should be present."

We all dislike to talk about trouble—but sometimes a stitch in time saves—USE NUCHAR FOR TASTE AND ODOR CONTROL.

•

With the floods now prevailing — you must use plenty of Chlorine—For Safety — Carbon will remove the chlorinous tastes — These two products work together — Especially true during flood epidemics.

INDUSTRIAL CHEMICAL SALES CO., INC.

230 Park Avenue
New York, N. Y.

418 Schofield Bldg.
Cleveland, Ohio

205 W. Wacker Drive
Chicago, Illinois

90,000 POWER HAMMER BLOWS....

15 HOURS OF BRUTAL PUNISHMENT

....couldn't make this joint leak a drop!

● WE wanted to find out just what MINERALEAD *would* stand!

So we took two 12 foot lengths of 4″ bell and spigot pipe—jointed them with MINERALEAD —and set them to form a span 19 *feet between supports*, with the joint centered under the hammer.

The hammer is a simple arrangement—a 4 x 4″ beam, secured at one end and actuated by the cam which you see on the near side of the pulley.

For good measure a 50 lb. chunk of iron was bolted to the impact end.

For fifteen hours straight the joint was pounded—100 blows a minute—90,000 separate impacts, each delivering tremendous punishment.

Ninety pounds water pressure was maintained throughout the test. At the end of the ordeal the joint was as dry as at the start. Not a *sign* of a leak.

That's the kind of joint MINERALEAD *makes*!

● ● ●

No pipe you lay is likely to ever have to stand such punishment. But you may be quite sure that the jointing compound that can take such rough treatment will not be bothered by *any* vibration, normal or abnormal, it will meet in service.

MINERALEAD means joints that stay tight permanently, under all conditions. That means trouble avoided and money saved. Want more information? We'll be glad to send it.

FOR JOINTING BELL AND SPIGOT PIPE

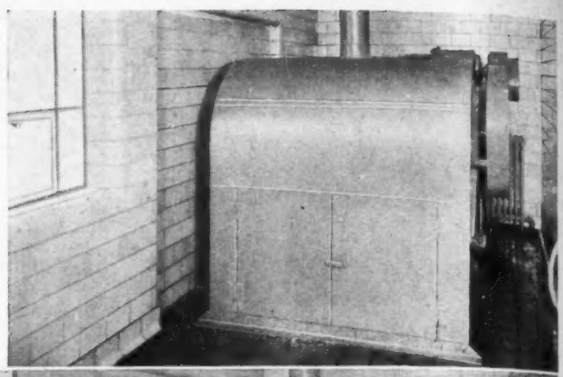
ATLAS [redacted] UCTS

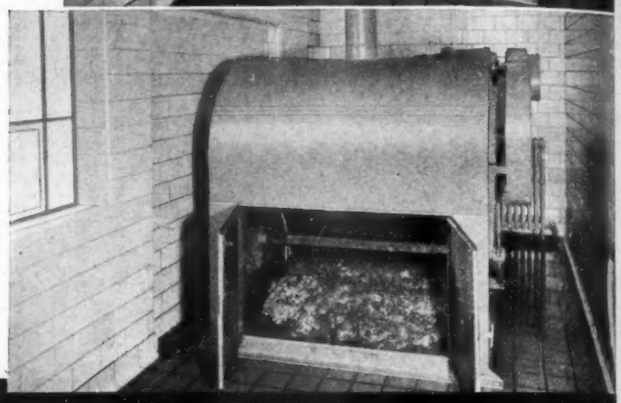
MERTZ[redacted] LVANIA

MINERALEAD

HOW TO HANDLE IT

IF IT IS SCREENING SEWAGE





Screenings are discharged into a shredder below and returned to the sewage flow—Rex Mechanically Cleaned Bar Screen, Janesville, Wisconsin. Joseph Lustig, City Engineer.

"Sturdy, Efficient Design—Low Head Loss Neat Appearance—Sure Cleaning"

These four reasons are the answer of experienced Consulting Engineers when asked why they have specified Rex Mechanically Cleaned Bar Screens in preference to all other screening equipment:

Sturdy, efficient design—Z-Metal Chain; no latches, cables, or delicate controls; totally enclosed drive unit.

Low head loss—Large unobstructed bar rack; no special by-pass or auxiliary bar rack required; installed in simple concrete channel; large reserve capacity.

Neat appearance—Totally enclosed head section; large access doors.

Sure cleaning—Rake cleans rack thoroughly; rags do not hang on rake wiper; easily kept clean.

These two screen room illustrations (above), taken during normal operation after months of service, show that screening equipment—Rex Screening Equipment—has kept pace with modern plant design both in efficiency and appearance. Rex Screens handle normal loads and storm overloads equally well. Reserve capacity and low maintenance are built into them. In conjunction with Rex Shredders they also provide screenings disposal in a compact, unified arrangement.

A new bulletin, No. 259, describes the many advances and the superior screening efficiency of this mechanism—and explains what they mean in the plant. Send today for your copy.

REX

CHAIN BELT COMPANY

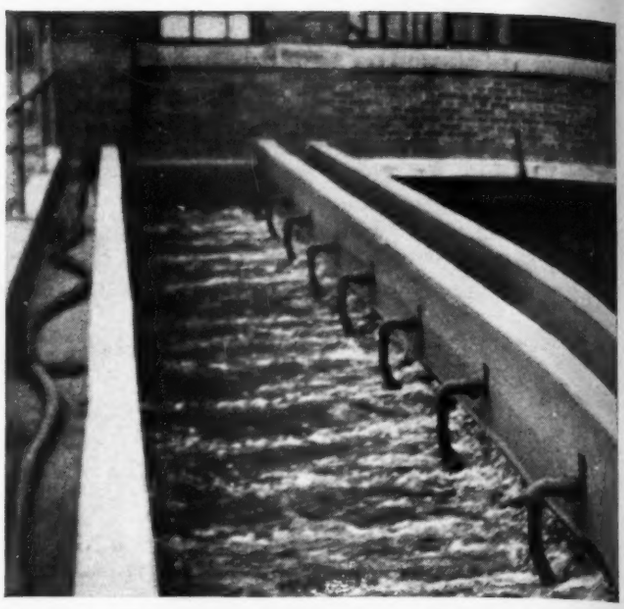
1610 W. Bruce Street, Milwaukee, Wisconsin

Sanitation Equipment

SCULPTURED IN TIN
BY E. L. BALCOM

IN the figure of the frontiersman America symbolizes the ancient virtues of courage, honesty and the adventurous spirit of discovery. In EBG, American users of Liquid Chlorine recognize these ancient virtues...in EBG's old fashioned ideals of fair dealing and integrity...in EBG's adventurous spirit of discovery that has brought new and profitable uses for Liquid Chlorine...greater efficiency in plant operation...a new conception of service. That's why many of the large users come to EBG—the Pioneer producer of Liquid Chlorine in the U.S.A.

ELECTRO BLEACHING GAS COMPANY, MAIN OFFICE: 9 EAST 41st STREET, NEW YORK, N. Y.· PLANT: NIAGARA FALLS, N. Y.



PROVED BY PERFORMANCE

JUST as in the manufacture of high quality abrasive and refractory products, the research and resources of The Carborundum Company have combined to produce the efficient, proved-by-performance, Aloxite Brand Diffusers.

Three important factors influence the superior performance of these diffuser mediums:

Uniformity—Similarity of structure of all diffusers furnished for any installation and of individual portions of each diffuser is an inherent property. The resulting uniform air diffusion means much to efficient and long performance.

Economy—Low pressure loss (friction resistance) and small bubble diffusion have long been features of Aloxite Brand Diffusers—again the result of years of research work. Low pressure loss means lower operating pressure with decreased power costs. Small bubbles mean doing the same oxidation work with smaller quantities of air.

Accurate Testing—Aloxite Brand Diffusers receive accurate permeability rating regardless of weather because they are tested in an air conditioned laboratory. This is important to uniformity. *For real performance use*

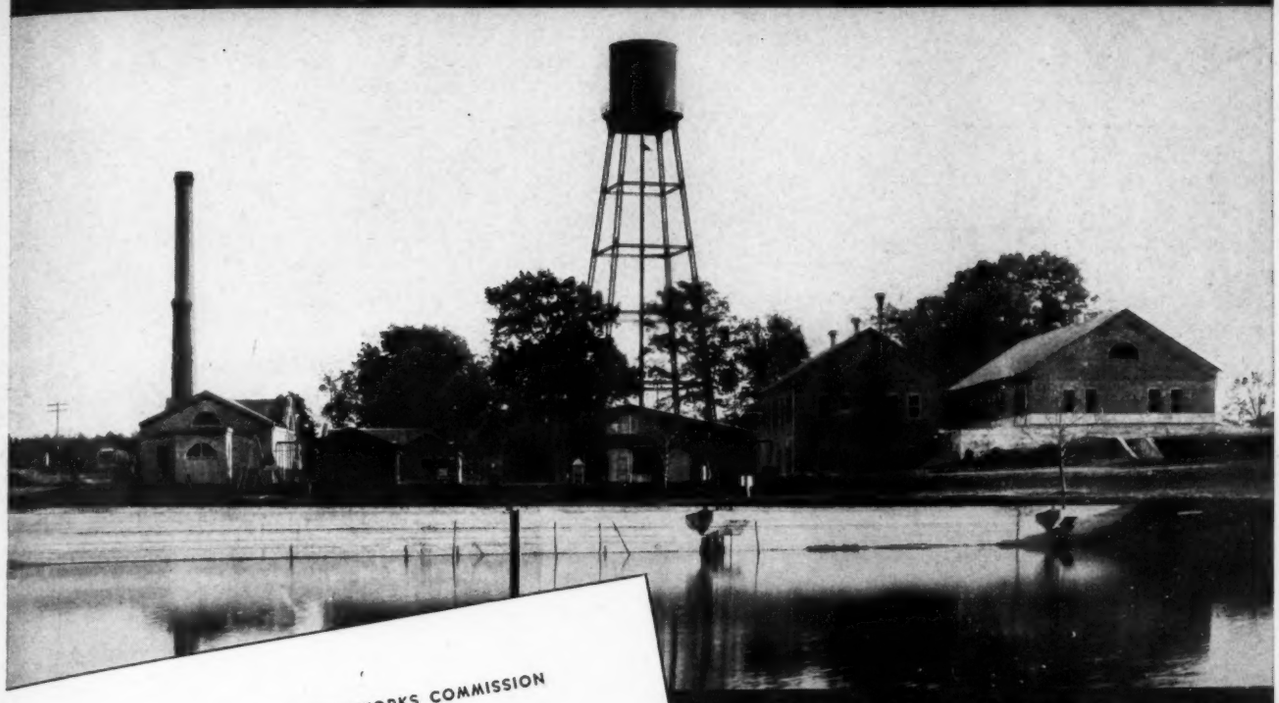
ALOXITE
REG. U. S. PAT. OFF.
BRAND
DIFFUSER MEDIUMS PLATES AND TUBES

THE CARBORUNDUM COMPANY
REG. U. S. PAT. OFF.
NIAGARA FALLS, N. Y.

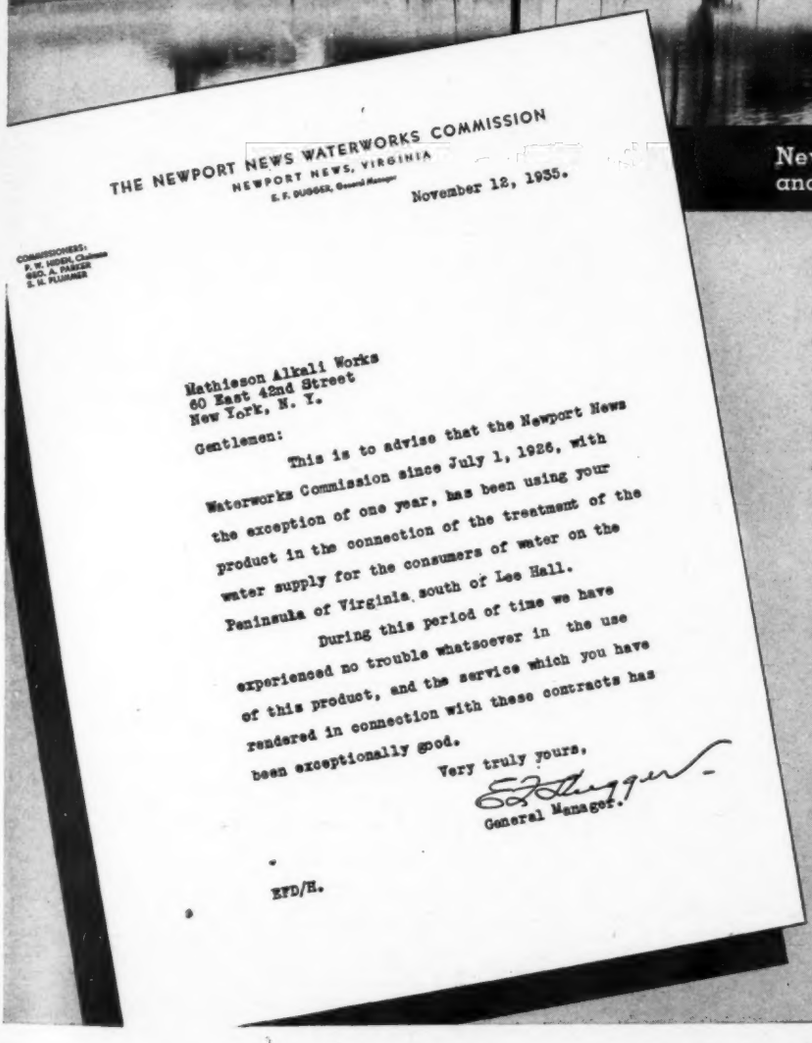
Sales Offices and Warehouses in New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Grand Rapids

(Carborundum and Aloxite are registered trade-marks of The Carborundum Company.)

THE NEWPORT NEWS WATERWORKS COMMISSION *Endorses* MATHIESON CHLORINE



Newport News Waterworks reservoir and pumping station at Lee Hall, Virginia.



THE NEWPORT NEWS WATERWORKS COMMISSION
NEWPORT NEWS, VIRGINIA
E. F. DUGGER, General Manager

November 12, 1935.

COMMISSIONERS:
F. W. HIGGS, Chairman
GEO. A. PARKER
E. H. PLUMMER

Mathieson Alkali Works
60 East 42nd Street
New York, N. Y.

Gentlemen:

This is to advise that the Newport News Waterworks Commission since July 1, 1926, with the exception of one year, has been using your product in the connection of the treatment of the water supply for the consumers of water on the Peninsula of Virginia south of Lee Hall.

During this period of time we have experienced no trouble whatsoever in the use of this product, and the service which you have rendered in connection with these contracts has been exceptionally good.

Very truly yours,

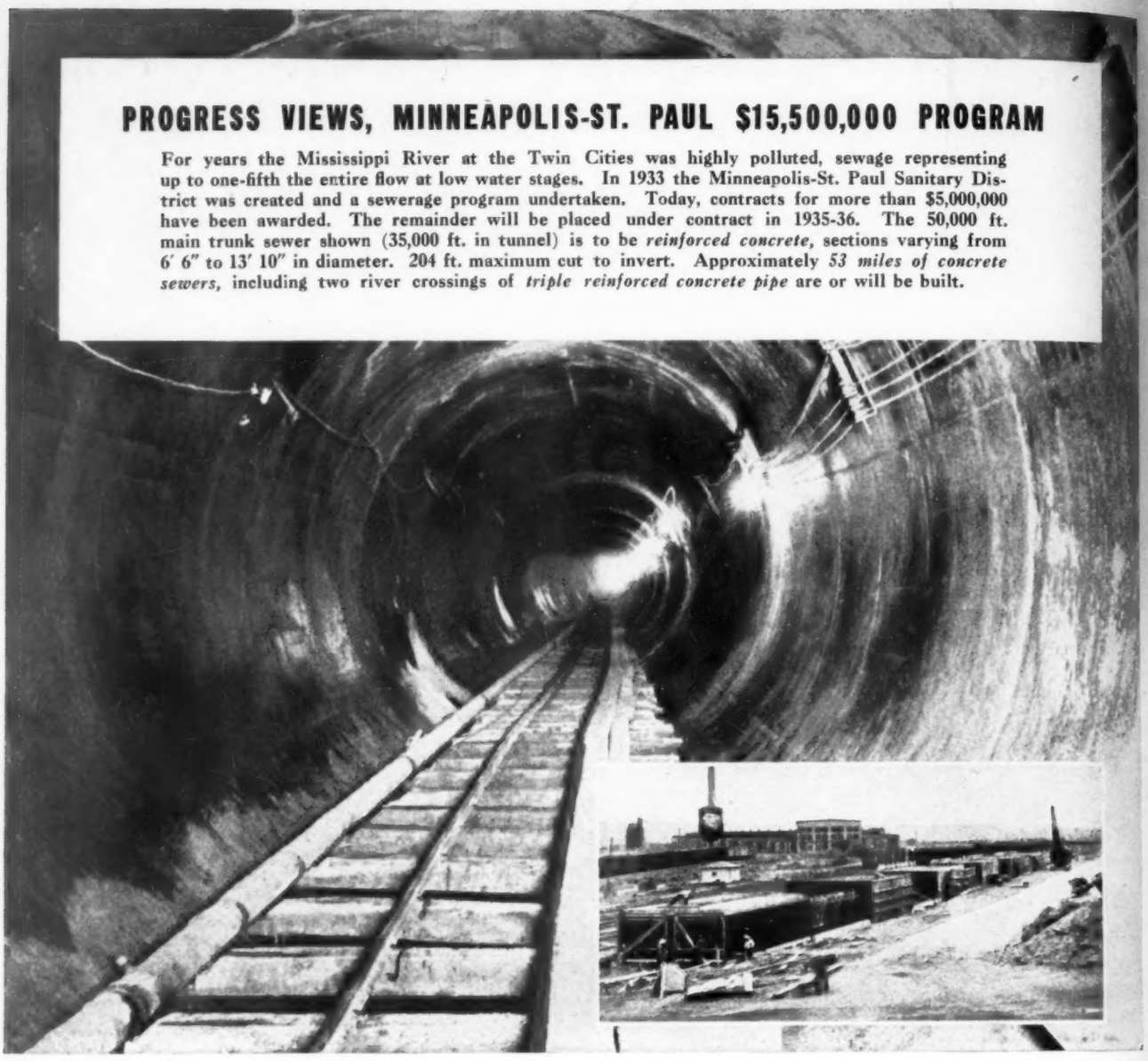
E. F. Dugger
General Manager.

EFD/H.

FOR the past ten years, Mathieson Liquid Chlorine has been used almost continuously in treating the water supply of Newport News, Va. During that time, as Mr. Dugger says in his letter, "We have experienced no trouble whatsoever in the use of this product, and the service which you have rendered . . . has been exceptionally good." In these few words is summed up the dependability of Mathieson Liquid Chlorine—a pure product, trouble-free containers and valves, prompt delivery service.

The **MATHIESON ALKALI WORKS** (Inc.)
60 East 42nd Street New York, N. Y.

Soda Ash . . Liquid Chlorine . . Bicarbonate of Soda . . HTH and HTH-15 . . Caustic Soda . . Bleaching Powder . . Ammonia, Anhydrous and Aqua . . PH-Plus (Fused Alkali) . . Solid Carbon Dioxide



PROGRESS VIEWS, MINNEAPOLIS-ST. PAUL $15,500,000 PROGRAM

For years the Mississippi River at the Twin Cities was highly polluted, sewage representing up to one-fifth the entire flow at low water stages. In 1933 the Minneapolis-St. Paul Sanitary District was created and a sewerage program undertaken. Today, contracts for more than $5,000,000 have been awarded. The remainder will be placed under contract in 1935-36. The 50,000 ft. main trunk sewer shown (35,000 ft. in tunnel) is to be *reinforced concrete,* sections varying from 6′ 6″ to 13′ 10″ in diameter. 204 ft. maximum cut to invert. Approximately *53 miles of concrete sewers,* including two river crossings of *triple reinforced concrete pipe* are or will be built.

WHERE MILLIONS ARE AT STAKE SEWERS ARE BUILT OF CONCRETE

ON big sewerage projects such as those of the Sanitary District of Chicago, Louisville, Detroit, Baltimore, New Orleans, and other large cities —why is concrete chosen?

Where sewage pours from miles of collecting sewers into intercepters and outfalls bigger than railroad tunnels — why the universal reliance on concrete?

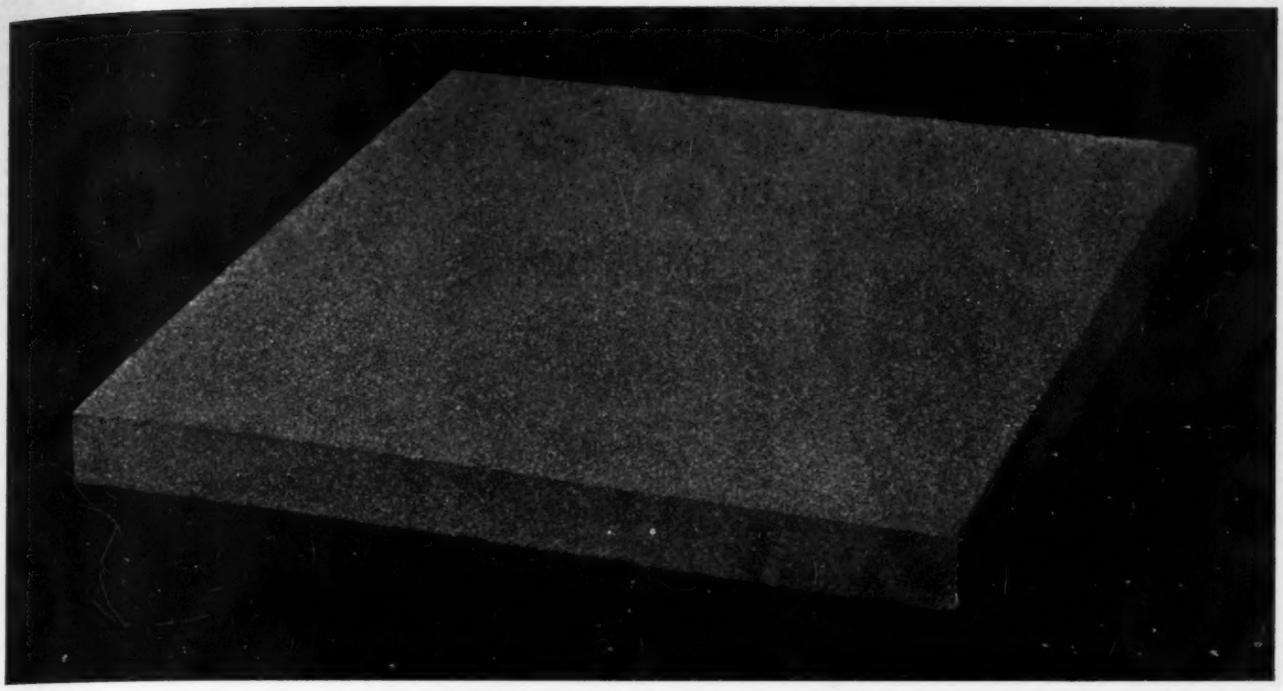
The answer is—concrete combines the necessary strength and durability at the most favorable cost. On its record this statement cannot be disputed.

Obviously concrete was chosen on these projects only after investigation proved its suitability. Whether *your* sewer is to be 12 feet in diameter—or only 12 inches—you play safe when you specify concrete.

Satisfactory sewer performance demands not only good materials but also proper design, construction and operation. Sewerage is a highly specialized field, and every project should be in the hands of an experienced sanitary engineer. Considering the investment his service is low cost insurance.

Facts on the use of concrete in sewers are available in booklets, *"Monolithic Concrete Sewers,"* and *"Concrete Pipe Sewers,"* free on request.

PORTLAND CEMENT ASSOCIATION
Dept. A4-29, 33 W. Grand Ave., Chicago, Ill.



In Three More Cities . . .

THE NORTON CONTROLLED STRUCTURE PLATE

TOPEKA, Kansas, has joined the long list of users of Norton Porous Plates while Springfield, Illinois, and Pasadena, California —for many years users of this product— are to equip new plant extensions with the Norton Controlled Structure Plate.

The Controlled Structure process of manufacturing is a patented Norton development —has resulted in a marked improvement in porous plates and tubes for activated sludge sewage disposal—has made it possible to regulate permeability, porosity, pore size and wet pressure loss much more exactly.

NORTON COMPANY
Worcester, Mass.
New York Chicago Cleveland

R-531

NORTON POROUS MEDIUMS

PARTIAL LIST OF SUBJECTS TO BE COVERED IN THE REFERENCE AND DATA SECTION OF THE MAY CONVENTION NUMBER OF WATER WORKS AND SEWERAGE

KINKS FOR WATER WORKS OPERATORS
- Methods of Cleansing Service Pipe
- Ridding a Reservoir of Tadpoles
- Location of Water Services
- Mud Balls in Filter Beds
- Valve Operation and Maintenance
- Stopping Flow from Broken Corporation Cocks
- Tapping Mains
- Correcting Red Water Troubles
- Etc., Etc., Etc.

KINKS FOR SEWERAGE OPERATORS
- Sewer Maintenance, Cleaning, Use of Effluents, etc.

CONVERSION FACTORS FOR ENGINEERS

INFORMATION ON WATER AND SEWAGE WORKS PROBLEMS—WHERE IT CAN BE FOUND

PRACTICAL HYDRAULICS

SELECTING THE RIGHT METER

CHLORINE—ITS HANDLING AND APPLICATIONS IN WATER AND SEWAGE TREATMENT

ADVANCES AND DEVELOPMENTS IN WATER CHLORINATION

ADVANCES AND DEVELOPMENTS IN SEWAGE CHLORINATION

METERAGE—METHODS, RATES, RESULTS
- Setting Meters
- Results of Meterage
- Meter Rates

LEAKAGE AND WATER WASTE SURVEYS
- Causes of Waste
- How Pitometer Survey Is Made
- What Water Waste Surveys Disclose
- Locating Leaks—Aquaphone
- Locating Leaks—Radio Finder

WATER MAIN CLEANING—WHEN TO CLEAN, METHODS, RESULTS

REHABILITATION OF OLD WATER MAINS
- Methods Employed—Results

THE INSTALLATION AND SERVICING OF POROUS AIR DIFFUSER MEDIUMS

TREATING WATER TO PREVENT CORROSION
- Red Water and Tuberculation

AMMONIA IN WATER TREATMENT
- When and Where Most Effective with Chlorination

METHOD OF ELIMINATING DEAD ENDS
- To Relieve Stagnation—Red Water—Bad Tastes

MAINTENANCE OF SANITARY SEWERS
- Root Control, Cleaning, Etc.
- A Root Proof Joint
- Maintenance due to the Misuse of Sewers
- Maintenance of Sanitary Sewers
- Cleaning Tools

WATER WORKS ACCOUNTING
- Uniform Classification of Accounts
- Billing and Collecting Methods in a Small City
- Accounting System for Large City
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GLOSSARY OF TERMS
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TABLES AND GRAPHS
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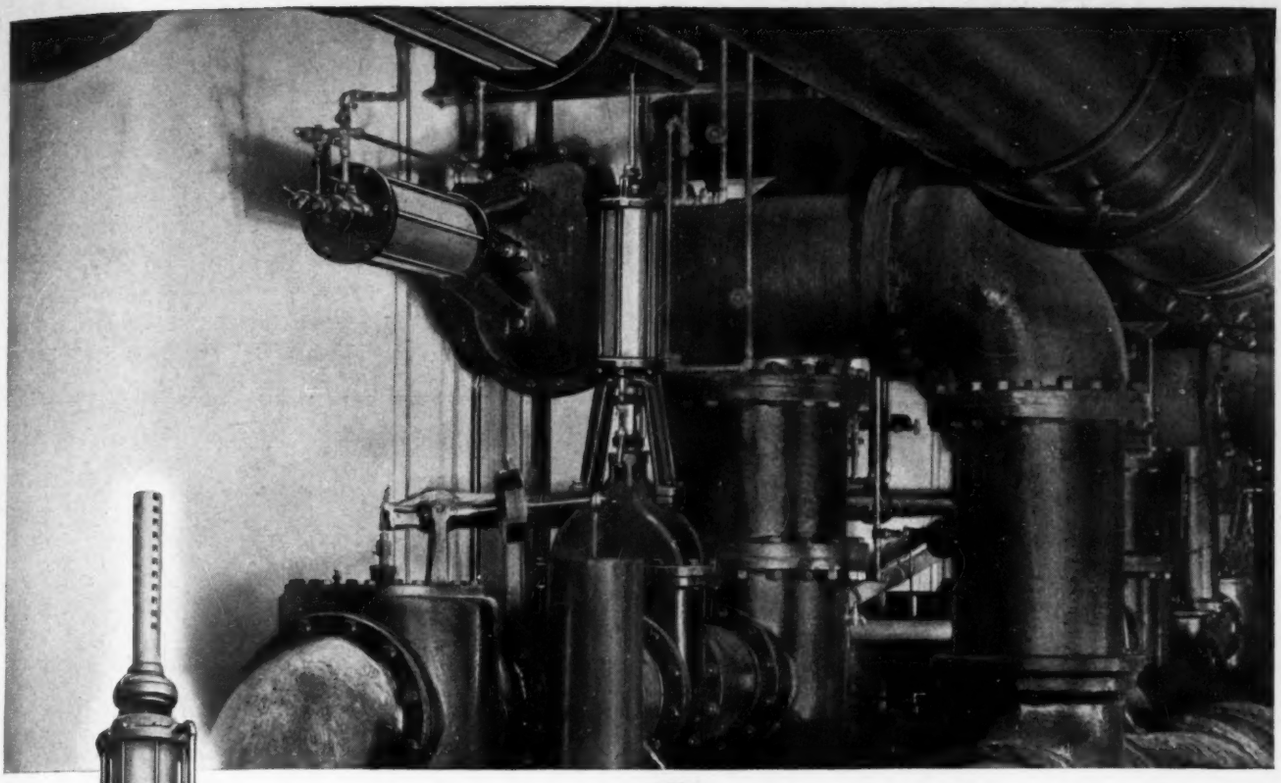

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The following tabulation **shows the percentage of cast iron pipe used in the water distribution systems of the 15 largest cities in the United States as reported by their Water Departments.**

CITY	PERCENTAGE
New York	97.2
Chicago	100.0
Philadelphia	98.3
Detroit	98.7
Los Angeles	74.0
Cleveland	98.9
St. Louis	98.7
Baltimore	99.7
Boston	99.8
Pittsburgh	97.9
San Francisco	76.8
Milwaukee	100.0
Buffalo	99.8
Washington D.C.	98.8
Minneapolis	95.8

INCLUDED in the 2471 miles of pipe in Philadelphia's water distribution system—*98.3% cast iron*—is the oldest cast iron water main in America, functioning satisfactorily after 114 years of service. With a peak consumption of 378 million gallons daily, Philadelphia's system has a pumping capacity of 705 million gallons daily of raw water from the Schuylkill and Delaware Rivers. There are more than 110 acres of slow sand filter beds.

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TRADEMARK REG.

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 83 APRIL, 1936 No. 4

METER TESTING AND REPAIR

Some Experiences at Louisville, Ky.

By CLEM. A. GALLAGHER

Superintendent of Services,
Louisville Water Co.,
Louisville, Ky.

The Author

RECENTLY while making a trip for the purpose of inspecting various meter shops throughout the country, one basic and sad truth struck me bluntly and forced me to a startling conclusion. One Waterworks Superintendent with whom I was speaking asked me flatly, "Can a water meter be repaired?," and the worst feature of this interrogation was that this man sincerely meant it. Whenever a water meter in his town gave trouble the practice was to pull it out, scrap it, and install a new meter. This was done whether the particular meter had given 30 years or 30 days of service.

The basic and sad truth is simply this: that despite all the progress made in the waterworks field in filtration, pumpage, construction and billing, yes, even in the meter field, a paradox still confronts us. The one sure-fire revenue producing instrument is seemingly neglected, if not ignored. Less, generally, is known about water meters than about any other essential waterworks mechanism. I am of the firm opinion that a definite, efficient, and consistent meter testing and repairing program is a vast asset to any Water Department or Water Company. The revenue accruing naturally from such a program will more than pay the initial expenditure for such a program in the first few years. The difference between 85 per cent and 100 per cent seems not so large arithmetically, but in just one service in one year's time it means many dollars and cents in any language.

Contrary to popular belief a meter testing and repair program is simple in itself. And the cost of such has been grossly exaggerated. I have but one purpose to fulfill in this paper and it is this: By explaining simply, and somewhat in detail, the meter plan we have been working successfully and reasonably in the Louisville Water Company, I hope to prove my contention that a definite, efficient, and concise meter testing and repair program is a vast and lasting asset to any water utility, irrespective of size. Further, that such a program can easily and reasonably be inaugurated and maintained. I hope that others may profit by hearing of our successes and our failures.

The author of this article came into the water works business, from the outside, to put accuracy and efficiency into the revenue producing division of Louisville's water utility.

He quickly sensed the fact that water meters deserved more attention than received in the great majority of instances and has set up a Meter Service Division which may well serve as a model in establishing the value of modernization in meter-shop practices.

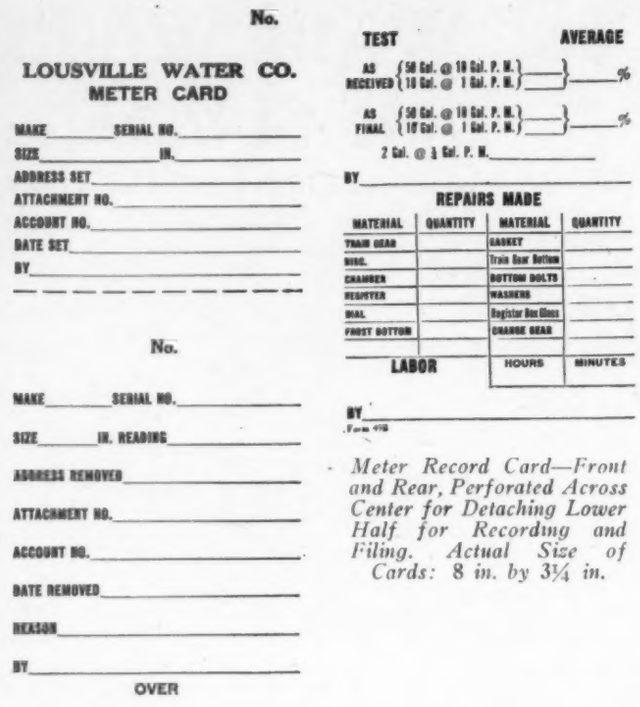
The author's background is of peculiar interest. All that he knew of metering in previous years was that pertaining to verse and hymns, for the Superintendent of Meters and Services of the efficient Louisville Water Works was at one time preparing himself to become a "Sky-Pilot."

Those who read this article will agree that he has discovered a lot about meters and metering of another sort during the short time he has been in the water-works business.—Editor.

The Four Phases of the Program

In such a definite program four phases comprising the composite must be considered and I shall treat of them in order. Meters must be exchanged, tested, repaired, and records kept of all these operations.

It stands to reason that any system which would insure an unfailing and accurate record of a meter, from the time it left the ground until it was returned after testing and repair, would be the most desirable method from every standpoint. This is our method. We have three men with small trucks exchanging meters daily and returning them to the shop. These men likewise take care of all meter complaints such as meters stopped, broken counters, leaks, etc. Normally each man and his helper will exchange about thirty-five meters a day. A card (here illustrated) has been devised to take care of all of the recording. This card is perforated midway and entwined with a wire at the top. The cards are numbered, and used and filed consecutively. On one side of the card at the top is a record for the meter reset after it has been repaired, tested and O.K.'d. Space is available for the make of the meter, the serial number,



No.

LOUSVILLE WATER CO.
METER CARD

MAKE_____SERIAL NO._____
SIZE_____IN._____
ADDRESS SET_____
ATTACHMENT NO._____
ACCOUNT NO._____
DATE SET_____
BY_____

No.

MAKE_____SERIAL NO._____
SIZE_____IN. READING_____
ADDRESS REMOVED_____
ATTACHMENT NO._____
ACCOUNT NO._____
DATE REMOVED_____
REASON_____
BY_____

OVER

TEST AVERAGE

AS RECEIVED { 50 Gal. @ 10 Gal. P. M. } ____ } ____ %
{ 10 Gal. @ 1 Gal. P. M. } ____ }

AS FINAL { 50 Gal. @ 10 Gal. P. M. } ____ } ____ %
{ 10 Gal. @ 1 Gal. P. M. } ____ }

2 Gal. @ ½ Gal. P. M._____

BY_____

REPAIRS MADE

MATERIAL	QUANTITY	MATERIAL	QUANTITY
TRAIN GEAR		GASKET	
DISC.		Train Gear Bottom	
CHAMBER		BOTTOM BOLTS	
REGISTER		WASHERS	
DIAL		Register Box Glass	
FROST BOTTOM		CHANGE GEAR	

LABOR	HOURS	MINUTES

BY_____

Meter Record Card—Front and Rear, Perforated Across Center for Detaching Lower Half for Recording and Filing. Actual Size of Cards: 8 *in. by* 3¼ *in.*

size, the address set, the attachment number, the account number, the date set. It is signed by the man placing the meter back in the ground.

The lower half of the card on the same side has the record of the meter removed with make, serial number, size, reading, address removed from, attachment number, account number, date removed, reason for removal (exchange, frozen, out of order, etc.), and also space for the signature of the man removing the meter.

Thorough Shop Records

On the other side of the card the upper half is blank while the lower half contains a complete record of the meter test and repair. Each meter coming into the shop has this attached card wired to the casing so that this same card remains with that one meter from the time it leaves the ground at one location until it is returned to the ground in another place. This obviates the danger of lost cards and garbled records. Each meter received in the shop is tested as received and tested, as final, after it has been repaired. Each meter is thoroughly cleaned and repaired irrespective of its first test average. Each ⅝-inch meter is tested with fifty gallons at ten gallons a minute and with ten gallons at one gallon a minute. The meter tester places both percentages on his card as well as the average of the two. The meter is then sent to the repair bench to be cleaned and repaired.

The lower half of this part of the card contains a list of the repairs made, parts replaced, and the time consumed in this repair. The material is listed on the card with a corresponding space for the quantity of each part used and the bin number from which it was taken. As a consequence, each man while repairing a meter must put down just what new part, or parts, he used, how many parts were used and how long it took him to finish this one meter. The meter repair man then signs the card and the meter is returned to the testing table. It then goes through its final test of fifty gallons at ten gallons a minute; of ten gallons at one gallon a minute, and of two gallons at one-fourth gallon per minute as a final check. The averages are again noted and averaged and this part of the card is then signed by the chief meter tester. If the meter does not register within two per cent it is returned to the bench for a further overhauling. If it, however, registers accurately the card is then severed at the perforation marks and the lower half returned to the meter record office. This card contains, therefore, for the clerks in the meter record department, complete information in regard to this one particular meter including the removal of the same with all statistics, the testing of the same and the repairing of the same. The signature of each foreman definitely places responsibility for errors under each classification. The information from these cards is transcribed to the regular permanent meter cards and the shop tag cards are then filed, according to their test number, in a file to fit this card. This gives the department a test and repair file.

The top half of the card remains, of course, on the meter until that meter is again taken out to be reset. Then in like manner the man resetting this meter or exchanging it for another fills out the information given above, disconnects the wire and card from the meter, signs the card and returns this reset information to the meter record department. We thus have a complete cycle for our exchange program and by the use of this simple card we have not only a method of double checking each step but also of definitely placing responsibility where it should be placed.

This exchange system, simple as it is, has worked out most successfully for us and should do so for others. The men exchanging meters take out each day just as many tested and repaired meters as they will exchange. This cycle keeps the shop free from meters piling up. At our present speed each of our 50,000 meters will be put through this process once every five years, although our tests (with our water and our meters) show that this period between tests for economy reasons should be lengthened appreciably.

Testing

Next we come to the testing of a water meter. As I have explained above, a meter is tested as received and again after repairs. The size stream for the test depends, of course, upon the size of the meter.

Our meter testing table can test ten ⅝, ¾ or 1 inch meters at a time. On an adjoining bench the larger meters, up to six inches, are tested one at a time. We have done away with the slower method of weighing for tests, and use only calibrated tanks and funnels. An hydraulic plunger keeps the meters in place. This test bench is so arranged that we can vary our stream anywhere from 225 gallons per minute down to 1/320 gallons a minute. The latter is accomplished by means of needle valves. Recently we have standardized on the sweep-hand dials on all meters, for two very definite reasons. First of all it is much easier to detect a leak on any size meter if it is equipped with a sweep hand dial, and secondly and even more important, it facilitates the testing of a meter in time saved and assures us that our registers are likewise accurate. We could not be sure of this by the use of test dials. Our meter tester and his helper average over one hundred ⅝ inch meters per day on standard tests. A cycle is likewise completed here, since in the morning meters are tested as final and in the afternoon as received. Thus the repair men on the bench work each day on the meters tested as received the previous afternoon while the meter tester tests as final in the morning the meters repaired the previous day.

It is noteworthy that our records show that less than one percentum of the total number of meters repaired have been unfit after repair, and have to be returned to

Meter Repair Shop, Louisville, Ky., Water Works

the bench. The promiscuous use of change gears is undesirable and we try to get away from it as much as possible.

Repairing

The next step in our meter routine is our repair bench. Five men work on this bench and each man has his own set of tools, his own sink with running hot and cold water, his own brushes and a hose with a stop-valve carrying compressed air of about seven to ten pounds pressure. This air is simply piped from our garage and reduced in the meter shop by means of a reducing valve. We have found that this compressed air at this pressure is most useful and practical for testing out the running smoothness of a meter as well as ejecting particles which may be holding back the best performance of a meter. It likewise does away with the necessity of the men placing their mouths on the outlet or inlet to a meter.

The meter bench is made of wood and covered with heavy galvanized iron. Above each man is an electric reflector which evenly lights up his place of work just where he needs it most. Each meter is placed in a separate pan to do away with the loss or mixing up of parts.

Our manner of cleaning a meter is simply the old fashioned but effective soap and water method. We deprecate the use of acid on any meter, or parts thereof, unless it is absolutely necessary. We have found that under our own water conditions the encrustation can be satisfactorily and more safely removed by good old hot water, soap, and elbow grease. We do no machining or reboring because, generally, replacement is cheaper and safer from every angle. Above the repair benches are marked and lettered compartments for the various parts of any size or make of meter. This is part of our permanent running inventory system. Each closed bin contains a different part and each bin is numbered. When the men need any new part for any meter they must mark on their ticket the number of such parts used as well as the bin number from which it was taken. A regular inventory clerk can thus keep, from these cards, a daily record of just what parts were used and how many of each part remains in stock. He has a standard minimum of each part that should be kept in stock. He can daily or on a moment's notice notify the department head just what parts are needed and how many of each, and they are then requisitioned and ordered. Again this inventory system, though simplicity itself, affords an easy check on costs, new parts required, etc.

Each man averages between fifteen and twenty meters a day, completely cleaned and repaired. The average cost, not including overhead, runs about fifty cents a meter for tests and repairs. We use about fifty new discs a month. Bottom bolts and gaskets most often need replacement. A meter is scrapped only after it is completely a liability. We have returned to service, meters, after overhauling and cleaning, which have been in the ground forty years and more. One man at another bench takes care of the registers, setting back to zero, lubrication, etc. We solder the counters and thus avoid ruining the gears by running counters back speedily with a motor driven disc. After cleaning, the registers of all meters are dipped in hot oil and then drained. This oil is fine, and not too thick for frigid weather. The meter shop is kept clean and each man knows just what he must clean up before he leaves. The work has been divided. The floor is waxed and a heavy, linked rubber carpet stretches all along the repair and test benches. On Saturday of each week larger meters, from one inch to six inch, are tested and repaired. Of course this work is slower and more tedious than that on 5/8 inch meters. A healthy spirit of competition, a desire to keep the meter shop clean and a pride in repair average, can work wonders if engendered and encouraged.

Meter Recording Office

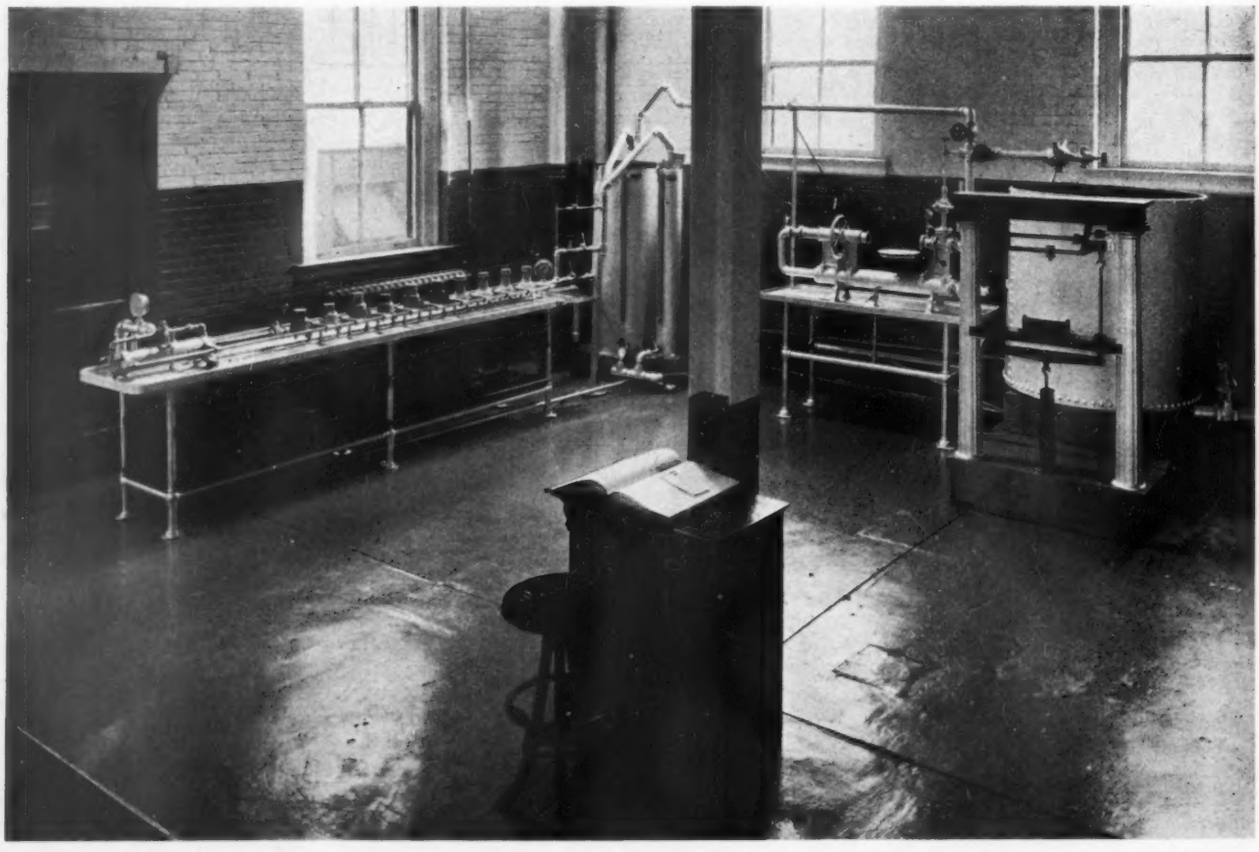
On the same floor is our enclosed meter record office. The head of the Meter Department and clerks keep all records of all meters. We keep two cards on each meter—one according to make and serial number and one according to the book and page number in the meter readers' books. All information—address, make, size, serial number, purchase date and price, sets and resets, tests and repairs, are kept on these cards. Any information concerning any meter in service at any address, any meter in the stock room, or in the shop, is available at all times. The city is divided into districts, lettered alphabetically, and a reference from card to meter book gives all information concerning readings, leaks, etc. The two sections of the numbered cards are filed separately after the information thereon has been transcribed to the other set of cards. These test and repair cards give the final shop information on any particular meter. This system of checks and balances assures accuracy, permanency, and simplicity. All necessary information is always at hand and any meter can be traced from the moment we receive it until we scrap it. We are at present about 75 per cent metered and have in the ground approximately 50,000 meters.

Selecting Meters

When purchasing a water meter three things must be taken into consideration, namely, accuracy, endurance, and interchangeability. It was our desire to find out just what meters would be most dependable under our water conditions and with this idea in mind we have been conducting a series of tests with new stock meters. Ten of each make are tested at a time. They are tested, as received, on flows of ten gallons a minute, one gallon a minute, one-fourth gallon a minute and one-twelfth gallon a minute. These same ten meters are then placed in an endurance test box in the basement and the water used in our building allowed to run through them until they register an average of five hundred thousand (500,000) gallons. We can vary this flow in the building as desired.

They are then taken back to the shop and retested exactly as above. These figures are then averaged with emphasis on the average percentage of inaccuracy and blue prints made of the same for permanent records. Next, these meters are taken apart and their parts interchanged. They are run then for approximately one hundred thousand gallons and retested again according to the former specifications. Finally they can be run on an absolute endurance test which, of course, takes time until one or more meters in any series breaks down. It is then taken apart and the cause of such a break down investigated. In this manner we have obtained, for most standard makes of water meter, very enlightening and most practical figures and facts. We have likewise made experimental use of the "gulper." In this manner we can run very small streams, record them in the calibrated tank, check the gulper and check the other meters in the series against this total.

Our endurance test box in the basement is so constructed that it will hold twenty-five meters at one time. It is arranged in a series of two boxes and any meter of any series, either series, or both, can be removed at any time by means of valves without affecting the flow of water in the building. Our figures on Louisville water and conditions, in many of these tests have been most startling, and seem to prove one thing very conclusively—that the A. W. W. A. specifications for 5/8 inch cold water meters are entirely too lenient. A well constructed water meter should register much better



Testing Benches and Equipment, Meter Shop, Louisville, Ky., Water Works

than 90 per cent on a one-fourth gallon per minute stream.

We recently made a meter under-registration survey. We brought into the shop at one time three hundred meters which had been in service five years or longer and tested them as received. The averages were startling inasmuch as the average percentage of inaccuracy on flows for all meters up to and including a one-fourth gallon per minute flow was far above standard requirements, for new meters.

It has been our endeavor in this entire meter setup to aim first at thoroughness, but thoroughness through simplicity. We believe we have accomplished our goal and through the cycles described in this paper are able to test and repair water meters regularly, accurately, efficiently and economically. The cost of this program will be as nothing compared with the revenue pickup naturally consequent on such a program—not to mention the life added to the meters.

Any water utility, which neglects to maintain a definite regular meter test and repair program is neglecting what should be considered a water company's greatest asset. As the meters go—so goes your revenue. A water meter Can be tested, repaired and kept in shape. Like anything else in life, so with water meters—the simplest and safest way is the best and the cheapest way.

Acknowledgment—The above paper was presented before the Kentucky-Tennessee Sect. of A.W.W.A. at Lexington, Ky., March 24, 1936.

▼

W. & T. Engineers Do Heroic Duty

Another page has been added to the drama of public health and chlorination. The emergency work of Wallace & Tiernan, engineers, in catastrophes is not news to health authorities and water works officials, but the service recently rendered in flooded areas deserves especial commendation and words of praise of those men who did heroic duty in getting emergency sterilization equipment through to hard-hit communities in distress, at a time when rail routes were not usable. All night travel over dangerous roads and circuitous routes and via air-ways (when available), plus the work of installation at the end of the journey, constitutes a part of the story.

Into the Pittsburgh area, as soon as flood news flashed, started W. & T.'s Manager of Service, Ed Reilly, with several engineers on a truck, loaded with chlorinators and emergency equipment. After all night travel by circuitous routings, to dodge impassable roadways, they reported next morning to State Health Authorities ready for "the day's work" where most needed.

The same night to Binghamton, New York, to answer an S.O.S. from the New York Department of Health, went another engineer with a consignment of emergency equipment for use in that area. He, too, was able to get through and arrive the next morning.

Then, into the Pittsburgh area went a second truck load of equipment and service men in charge of Engineer R. B. Powell, following all night routings fought through by the "path-finder" truck under Reilly.

On the heels of Pittsburgh, came the New England flood with the resulting emergency calls. Answering these, W. & T. engineers found airplanes available, the accompanying picture being of a chartered American Airways plane being loaded with emergency chlorinating equipment for the flooded area.

The Airplane in Catastrophes: Emergency Chlorinators En-Cargo Ready for the Hop into Flood Stricken Fields

It has been learned that normal production all but ceased in the W. & T. factory while twenty of its engineers and service men were rushed into flooded sections for catastrophe duty, assisting stricken communities and health authorities.

It seems that some award should be available to an organization performing this type of service which is more lasting than passing acknowledgment and credible publicity.

▼

Harry U. Fuller Elected Chairman New England Section A. W. W. A.

At the annual meeting of the New England Section of A. W. W. A., Harry U. Fuller, Chief Engineer and Manager of the Portland (Me.) Water Utilities District was elected Chairman of the section.

Harry U. Fuller

Other officers:

Vice Chairman — Chas. W. Mowry, Factory Mutual Ins. Co., Boston, Mass.

Sec'y-Treas.—Samuel M. Ellsworth, Cons. Engr., Boston, Mass.

Trustee—Frank A. Marston, Metcalf & Eddy, Engrs., Boston, Massachusetts.

Trustee—Harold W. Griswold, Water Commission, Hartford, Conn.

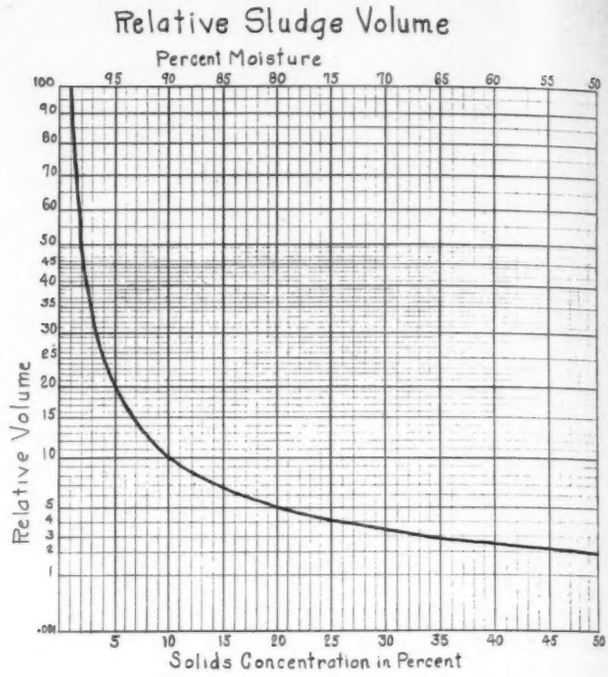


Fig. 2. — Relationship Between Relative Volumes and Changes in Solids Content of Sludges.

CENTRIFUGAL DEWATERING OF SLUDGES

Part I—Theory, Principles and Applications

By PHILIP B. STREANDER,

Watson and Streander, Engrs., New York, N. Y.

AT THE present time considerable thought and attention is being given to the urgent problem of the mechanical dewatering of sewage sludges, one instance being the application of vacuum filters for the purpose.

The Author

In the general evolution of this problem, centrifugal clarification is now being offered by various manufacturers not only as dewatering equipment—designed to take all of the sludge, reduce it to a low moisture content and prepare it for efficient and economical incineration—but if experimental work and claims can be proven and justified, it offers possibilities of eliminating digestion tanks, sand drying beds, etc., and centrifugal sludge "wringing" in conjunction with incinerators can be utilized for the complete disposal of all sludges derived in the treatment of sewage.

Mr. Streander's article, too voluminous to present in a single issue, will be continued. Part II will deal with the design of centrifugal machines, now available, and set forth their characteristics. It will present those pertinent facts concerning performance, capacities, etc., which the author has been able to assemble.—Editor.

History in Brief

Centrifugal extractors and clarifiers have been and are being widely used in the desiccation and lixiviation of various salts, the purification and separation of waste liquids, coal sludge, chemical products, cellulose, etc., and in the sugar, oil and other industries. This article, dealing with centrifugal dewatering of sewage sludges, is however primarily confined to centrifugals applied to this particular phase of work. In 1902 Schaefer at Cologne, Germany, constructed what was probably the first sludge centrifuge. This type of machine was further developed by ter-Meer and so-called Schaefer-ter-Meer machines were installed at Frankfort and Hanover in 1907-1910.

The next development, 1913-1914, consisted of the substitution of a single solid drum for the six compartment drum and means for automatically unloading the dewatered cake. This machine was of a type which might be termed a combination of the fill and draw and the continuous flow type, in which sludge entered the machine until the sediment chamber was practically filled. This type of machine replaced the older type at Hanover and Frankfort and was used in this country for experimental work at Milwaukee on the dewatering of activated sludge. In 1923-1924 still further improvements were made consisting principally of the addition of a secondary dewatering drum, mounted over the main dewatering drum. This machine, called the Bescoter-Meer, was used in the Baltimore experiments in 1924-1925 and while indicating an improvement over the other type, still allowed a considerable quantity of suspended solids to be discharged with the filtrate from

the machine. In 1928-1929 ter-Meer developed the horizontal type centrifuges which are now in operation at the Frankfort and Hamburg (Germany) sewage treatment plants.

At or about this time experimental work on a centrifugal machine was carried on by the Automatic Centrifugal Corporation using the Herr patents. In 1933 an associate company, the American Centrifugal Corporation, engaged Joseph S. Pecker, a Consulting Engineer of Philadelphia, who undertook the further development which culminated in a final automatic centrifugal machine, which is now in operation at Collingswood, New Jersey. Duerig at Philadelphia developed and built a continuous flow centrifuge and H. B. Cleveland of New York has developed a horizontal continuous flow type having integral therewith a filter to remove the solids from the filtrate. In 1933 the Sharples Specialty Co. ran experiments on the dewatering of waste activated sludge using their high speed centrifuge and also have secured the American rights to the manufacture and sale of the Humbolt horizontal centrifuge, a machine somewhat similar to the ter-Meer horizontal type of centrifugal.

The Principles of Centrifuging

When a mixture of oil, water and sediment is allowed to stand the oil will rise to the top, the water sink below it and the sediment will rest on the bottom of the container. If the same mixture is placed in a rotating container the suspensions will assume a vertical form against the side of the container. As the direction of centrifugal force is outward from the axis of rotation, suspended particles (sediment) heavier than the fluid medium tends to pass toward the periphery and to deposit on the wall of the revolving container. Material or particles lighter (oil) than the fluid medium tends to pass toward the axis of rotation and to form a column on the inner surface of the fluid medium. With a stationary container the rate of settling or subsidence is determined by the force of gravity acceleration but when this is a high centrifugal force, many times the force of gravity, the velocity or rate of settling is correspondingly increased.

The manifestation of centrifugal force is well known and is the result of the disinclination of a moving body to make a change in direction. Centrifugal force measures the amount of change in relation to the time required for such change. When a body at a given speed turns a sharp corner more centrifugal force is generated than when the change of direction is gradual. A centrifuge consists of a hollow cylindrical vessel rotating about its axis and within it the material to be dewatered by centrifugal force and the change in direction is fixed depending on the diameter. The content of the cylinder, attempting to travel in a straight line, is having a constant change in direction forced upon it which is restrained by the cylinder walls. The well known equation for centrifugal force

$$F = KN^2R,$$

in which F = Number of times force of gravity developed
N = Revolutions per minute
R = Radius in inches
K = 0.0000284 when R is expressed in inches,

shows that while the force developed varies directly as the radius, it also varies as the square of the revolutions per minute. The bursting strain to which the bowl or basket is subjected is in direct proportion to its peripheral speed. A comparison of the centrifugal force generated is shown in Fig. 1 where an object on a one-foot radius traveling at a peripheral speed of 1,000 feet per minute generates a centrifugal force twice that of the same object on a two-foot radius traveling at the same peripheral speed. The centrifugal force developed on materials may be many thousand times the force of gravity but it is always uniform at a constant distance from the center of rotation.

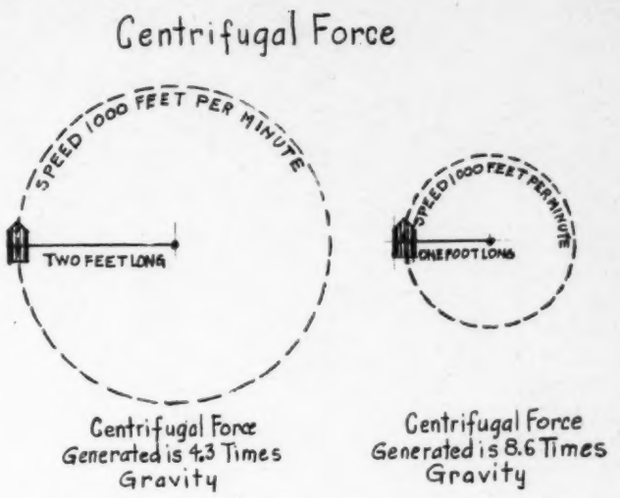

Centrifugal Force
SPEED 1000 FEET PER MINUTE
TWO FEET LONG
SPEED 1000 FEET PER MINUTE
ONE FOOT LONG
Centrifugal Force Generated is 4.3 Times Gravity
Centrifugal Force Generated is 8.6 Times Gravity

Fig. 1.—Centrifugal Force vs. Gravity Illustrated.

Sludge Characteristics

The specific gravity of sludges is subject to considerable variations. It is largely influenced by the personal habits of the contributing population and also by industrial wastes, the age of the sewage when it reaches the plant, and to an even greater extent by the method of treatment used in the removal of the solids from the sewage. These factors are the direct cause of many variations in the specific gravity, the physical characteristics and the chemical composition of the sludge. The specific gravities of various kinds of sludges are approximately as follows:

Activated sludge	1.004 to 1.008
Chemical sludge	1.01 to 1.04
Raw sludge	1.02 to 1.03
Digested sludge	1.04 to 1.08

The foregoing specific gravities are, of course, approximate and are subject to considerable variation and pertain to the sludge as removed from the tanks. Certain sludge ingredients have a specific gravity so close to that of the liquid phase that even with extremely high centrifugal force it is difficult to separate them from the liquid. Fresh sludge contains organic substances of colloidal consistency which cannot be precipitated by even an optimum centrifugal force as it is highly miscible and may form an intermediate layer between the sludge cake and the liquid.

Sewage sludge as taken from a settling tank is that which has been separated from the sewage by sedimentation under the force of gravity. The density of concentration of the sludge depends on the character of the sludge ranging from 4 to 8 per cent for raw sludge as taken from a primary settling tank, 0.5 to 2 per cent for activated sludge from a secondary settling tank, 2 to 4 per cent for mixtures of waste activated sludge and raw sludge taken from a primary settling tank and from 3 to 8 per cent for chemically precipitated sludge. *The work of centrifugal dewatering devices commences at the point at which the work of gravity ceases;* or (see Fig. 2) on those sludges ranging between 8 per cent and 1 per cent solids concentration.

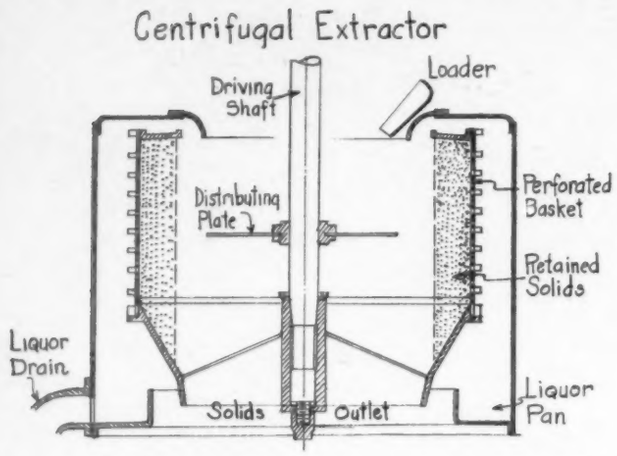


Fig. 3.—Illustrating the Principle of a Centrifugal Machine of the Perforated Bowl Type.

If sludge is removed from a settling tank at a slow rate, so as to maintain its concentration at the highest practicable point, it will for all practical purposes be in equilibrium. If this sludge is then subjected to a high centrifugal force, the equilibrium will be altered and further separation of the liquid and solids will take place. Thus a centrifugal clarifier is capable of separating suspensions which will not separate further by the force of gravity alone under any condition.

Types of Centrifuges

Centrifugal machines are of two general types. Centrifugal extractors, or dehydrators, have perforated baskets. Centrifugal clarifiers have solid drum baskets. Centrifugal extraction accomplishes the removal of solids from the liquids by discharging the liquid through perforated baskets or filters which retain the solids. Centrifugal clarification is a process of stratification by subsidence, in which the liquid does not pass through a retaining membrane or medium, and separation takes place by virtue of the difference in the density or specific gravity of the suspended solid and the liquid components. The centrifugal extractor or hydroextractor (Fig. 3) generally consists of a vertical or a horizontal basket having a perforated side wall which retains the solids and through which the liquids are discharged into an outer chamber. The dewatered solids are then manually or mechanically removed from the side wall and discharged from the bottom of the basket.

Centrifugal clarification is analogous to the operation of a settling tank with centrifugal force increasing the subsidence value of the sludge particles many hundreds of times. The Resines process (Fig. 4), which was developed primarily for the sugar industry, gives a typical illustration of the action of centrifugal clarification as compared to a settling tank. Liquid enters through a pipe which can be considered as the influent to a tank and is discharged onto the lower part of the rotating solid drum which would be the tank. After the drum is filled, additional liquid must travel a sinuous path until discharged. During the time of such travel, centrifugal force acts on the liquid and the suspended solids in the ratio of their respective gravities. About two-thirds of the volume of the drum may be considered as space for the accumulation of the solids or the sludge space, the other third being settling chamber through which the liquid flows to the outlet end. The travel of the liquid is in a helical course and may amount to between 2,000 and 3,000 feet which would be the length of an equivalent settling tank. The type of centrifuge shown is comparable to a semi-continuous flow settling tank in which the flow of sewage must be shut off during the time of sludge removal. Other types of centrifugal clarifiers are comparable to (1) fill and draw settling tanks, (2) continuous flow, and (3) a combination of the two depending on the construction and operating features of the machine.

Evaluations and Ratings of Centrifuges

In the mechanical dewatering of sludge, expressing the sludge in terms of per cent solids concentration, rather than the per cent moisture, gives a clearer conception of the work done by centrifugals. For example, the expression 99 per cent moisture naturally means 99 per cent liquid and 1 per cent solids, and 98 per cent moisture would be 98 per cent liquid and 2 per cent solids, but it does not indicate sufficiently that the volume in terms of bulk or weight in the second instance has been reduced by 50 per cent. It is, therefore, considered that the proper nomenclature to be used in this discussion is the solids concentration of the sludge wherein 1 per cent concentration means 1 part of solids to 99 parts of liquid and 2 per cent concentration describes a sludge having twice the density of a 1 per cent sludge, etc. For convenience in reference the term "relative volume" will also be used which herein indicates the volume of sludge at any concentration, expressed in terms of the volume having a base value of 100. This is shown in graphic form in Fig. 2, wherein a sludge volume having 1 part solids and 99 parts liquid (1 per cent concentration), is designated as 100; and, 2 per cent concentration as "relative value" 50, 5 per cent as 20, etc. The use of this figure quickly gives the volume of any sludge concentration in terms of other concentrations. For example, 2 per cent concentration has a relative volume of 50 as compared to 10 per cent concentration having a relative volume of 10. It is plain thereby that the latter has one-fifth of the volume of the sludge having a 2 per cent concentration.

Effect of Concentration on Capacities.—It can be readily appreciated that the initial density of the sludge to be dewatered has a decided effect on the capacity of a centrifugal clarifier. In the batch type of machine low concentrations mean an increased number of batches. In the semi-continuous type of machine low concentrations either reduces the detention period, resulting in a higher solids content in the filtrate, or reduces the out-

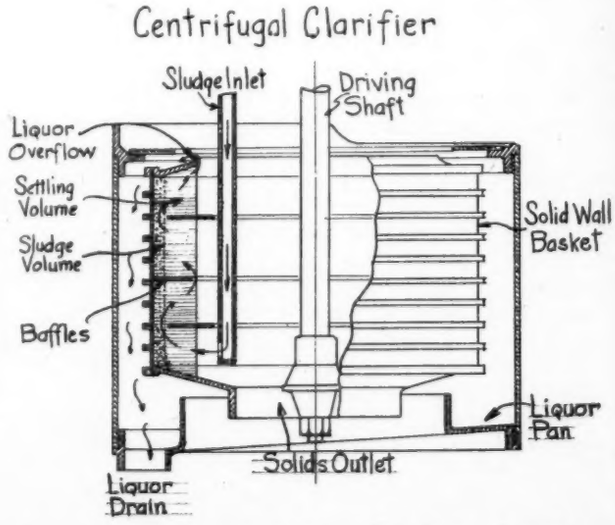


Fig. 4.—A Centrifugal Machine of the Solid Bowl Type.

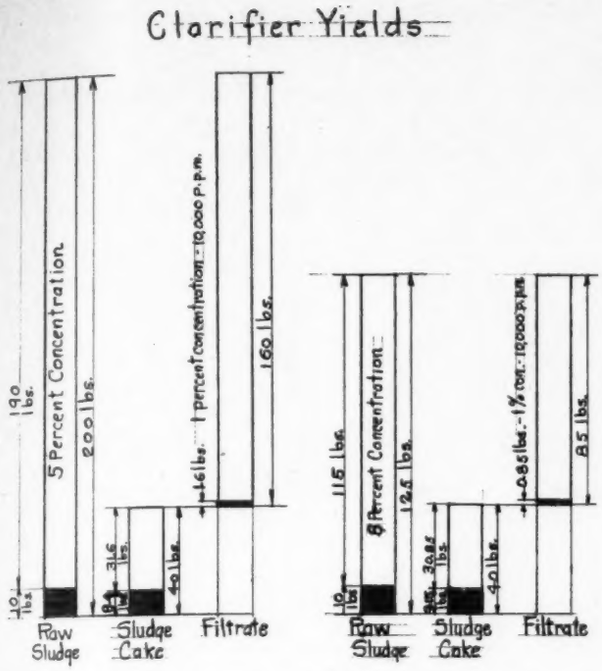


Fig. 5.—Illustrating the Ratio of Sludge Cake Volume to Density of Sludges Handled and Possible Centrifugal Yields.

put of the machine in terms of sludge cake. For example, a sludge having 2 per cent concentration has twice the volume of one having 4 per cent concentration. For the batch type of machine the time of dewatering would then be twice as long for the 2 per cent sludge as for the 4 per cent sludge. With the semi-continuous batch type, the rate of flow through the settling space being equal for the two concentrations, again shows that the time of loading would be about twice as long for the 2 per cent as for the 4 per cent concentration.

Clarifier Yields.—The capacity of a centrifuge is determined by its yield, that is the amount of material recovered from the sludge computed on the dry basis. A typical example of this is shown in Fig. 5, being two sludges of different concentrations, wherein it is assumed that the cake volume and the solids in the filtrate will be the same for the two sludges. In the case of the 200 pounds of sludge having a concentration of 5 per cent and a filtrate containing 10,000 p.p.m. suspended solids, the resulting cake (21 per cent solids), would have a weight of 40 pounds, having been reduced in volume by 80 per cent. The yield of the centrifuge would, thereby, be 84 per cent based on the dry solids content. Taking the same 10 pounds of sewage solids (dry basis), in a concentration of 8 per cent, with a filtrate also having 10,000 p.p.m. suspended solids, the resulting cake (22.9 per cent solids) would have a weight of 40 pounds, having been reduced in volume by 68 per cent. With 9.15 pounds solids recovered the yield would be 91.5 per cent. Another illustration, showing the effect of the initial concentration on the capacity and yield of a centrifugal clarifier, is given in Fig. 6. Here are shown two sludges—"A" having an initial concentration of 8 per cent and "B" an initial concentration of 5 per cent. It has been assumed that both sludges will dewater to the same final concentration of 30 per cent solids, and that both sludges contain "light solids" in the same amount (namely one-half pound) which are not subject to removal by centrifugal clarification. The "A" sludge, having 8 pounds of dry solids per 100 pounds of sludge, produces 75 pounds of filtrate containing 6,700 p.p.m. (0.67 per cent) suspended solids and 25 pounds of dewatered sludge cake having 7.5 pounds of dry solids and 17.5 pounds of water. The sludge has been reduced to one-quarter of its original volume and the centrifuge has given a yield of 94 per cent. The "B" sludge, having a concentration of 5 per cent (5 pounds of dry solids per cwt.) produces 85 pounds of filtrate having 5,900 p.p.m. (0.59 per cent) of suspended solids and 15 pounds of dewatered sludge cake containing 4.5 pounds of dry solids and 10.5 pounds of water. The sludge has been reduced to 15 per cent of its original volume and the centrifuge has given yield of 90 per cent or has recovered nine-tenths of the dry solids present in the original sludge.

Capacities in Terms of Dry Solids.—In view of the foregoing variations in sludge, their characteristics, types, initial concentration, etc., and the various types of centrifugal clarifiers, it is exceedingly difficult to formulate any definite expression to evaluate and rate this type of sludge dewatering equipment in terms of comparative capacities. To rate the machines on the basis of volume or weight of sludge input would not be fair as this would not take into consideration the initial concentration of the sludge. Rating the machines on the basis of dewatered sludge output does not take into consideration the initial and final sludge concentration. Both the capacity and the power requirements are further influenced by the dryness required in the sludge cake. For instance, to raise the solid concentration in the sludge cake from 30 per cent to 40 per cent may require half again as much power as is required to increase it from 8 per cent to 30 per cent. It would, therefore, appear that *the only logical basis for rating centrifugal clarifiers is on the basis of dry solids input and output;* and, further, differentiating between the kinds of sludge handled.

Another factor, having a bearing on the capacity required for the mechanical sludge dewatering equipment, is the operating time of the machines. While the volume of sludge produced per day in the treatment may

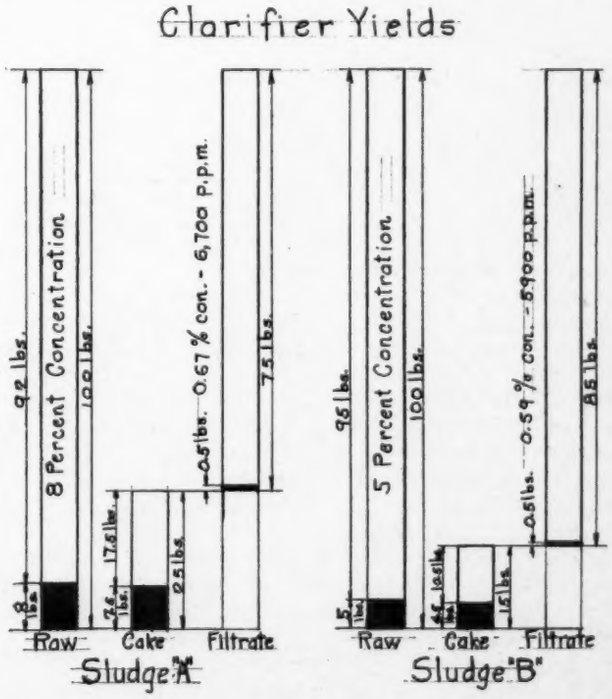


Fig. 6.—Another Aspect of Centrifuge Loadings and Yields—Showing the Value of Pre-Concentration of Sludges.

vary to some extent, the capacity of the dewatering equipment must be based on a certain maximum rate. If it is assumed that the maximum rate of sludge production would be 48,000 gallons per day, the dewatering of this in a 24-hour period would be at the rate of 2,000 gallons per hour. For eight-hour operation only there would be required at least three times the centrifugal capacity needed for 24-hour operation.

Applications of Centrifugal Clarifiers

Dewatering of sewage sludge by means of centrifugal clarifiers has the promise of being an inexpensive and simple method for increasing the concentration of fresh sludges from say 3 to 8 per cent to above 40 per cent. Sludge containing approximately 30 to 35 per cent of dry solids is similar to moist earth and can be readily shoveled—and such a concentration places it below what may be termed the "critical" moisture content, that is to say, under the point at which putrefaction is an active condition. By reducing the moisture content to this point many days are required before it can become active and concentrated fresh raw sludge can be stored and handled for a considerable lnegth of time without causing undue nuisance because it will act like ordinary fresh sludge.

Manner of Installing and Operating.—The manner in which centrifugal clarifiers should be installed and operated is a question which, in the absence of definite operating results, merits considerable attention. In the type of machines now built for this purpose it is essential and almost imperative, for proper operation, to endeavor to maintain the initial concentration of the entering sludge at a constant figure, as otherwise the controls must be constantly readjusted to meet the variations in concentration. Thickening of the sludge is also beneficial as the required capacity, reflected in drum volume for the true batch type (in settling and cake volume for semi-continuous type) is thereby increased. This can be readily demonstrated in wasted activated sludge. Coming from the tank this may have a concentration of say 1 per cent, which if increased by thickening to 2 per cent, will reduce the volume to be handled by 50 per cent. Such a reduction will naturally reduce the working time of the centrifugals and thereby effect considerable savings in power costs. This thickening also applies to raw sludge but to a lesser extent.

For installation of centrifuges dewatering raw sludge, present developments indicate that the sludge should flow or be pumped into a storage tank placed at such an elevation as to allow gravity feed to each machine. The tank or tanks should be provided with decanting devices to draw off any supernatant liquor which may accumulate. A power driven agitator should be installed to keep the sludge in constant circulation to give a uniform concentration to the sludge flowing to the machines. Concentration devices are of benefit, but conditioning of the sludge prior to dewatering has not proven to be of material aid in the separation of the solids. The filtrate from the centrifugal can be piped to a sump from which it can be pumped out and returned to the raw sewage. Should the suspended solids content of the machine effluent be above the allowable limit for plant loading, the filtrate can be discharged into a conditioning tank wherein coagulating chemicals can be added for the precipitation of the solids. The dewatered sludge cake can be discharged onto belt conveyors, or properly designed screw conveyors, and transported to its ultimate point of disposal.

Effect of Machine Effluent on Treatment.—A very important factor in the application of centrifugal clarifiers to the dewatering of sludge may be the effect of the filtrate on the operation and treatment results in the plant. The filtrate from centrifugal clarifiers may have a suspended solids content and a B.O.D. many times that of the raw sewage and its return to the raw sewage may have a deleterious effect on the treatment of the sewage. The solids content and the B.O.D. of the filtrate depends largely on the kind of and the characteristics of the sludge being dewatered. If the raw sludge is stale and septic the filtrate will have a high solids and B.O.D. content, whereas a fresh raw sludge will dewater more readily with a consequent lessening of the solids and the B.O.D. In waste activated sludge dewatering, the filtrate is comparatively clear and has a low B.O.D. The same holds true for chemically precipitated sludge if it is dewatered while it is still fresh. A mixture of waste activated sludge and raw sludge approaches the conditions applying to raw sludge and for all practical conditions should be classified as such. Due to the action of chemical flocculation and biological flocculation (activated sludge process) and the inherent nature of the two systems, the return of filtrate, derived in the dewatering of waste chemical or activated sludge, does not build up "fines" in the system. The suspended solids in the filtrate from these two kinds of sludge coagulate and settle out even more rapidly than the effluent from the aeration or the chemical flocculation tanks.

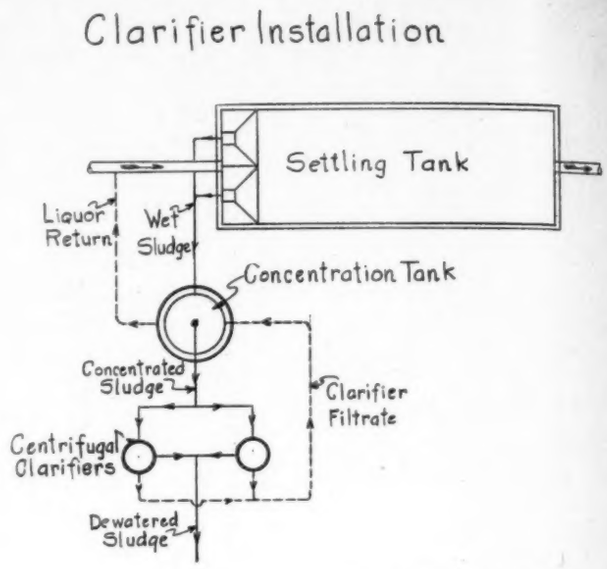


Fig. 7.—Sketch of Layout for Pre-Thickening of Sludge and Centrifugal Effluent Handling.

Effect of Ether Solubles.—In the operation of centrifugal clarifiers, grease being lighter than the liquid and sludge particles, collects on the inner surface of the drums and with some types of machines is discharged with the filtrate. The ether-soluble matter of average domestic sewage ranges between 40 and 50 p.p.m., corresponding to between 300 and 400 pounds (dry basis) per million gallons, the amount removed varying depending largely on the method of treatment used. In plain sedimentation a considerable part of the ether-solubles is contained in the non-settling lighter sludge particles passing out with the effluent and the amount actually retained in the settled sludge probably ranges between 20 and 40 per cent. In activated sludge and chemical flocculation and precipitation plants this may be increased to between 30 and 80 per cent. The analyses of various sludges indicates that the ether-soluble con-

tent may range between 8 and 20 per cent of the total solids (dry basis). In centrifugal dewatering the speed of the machines sets up a high air velocity inside of the drum with the result that minute air bubbles are entrained in the grease and decreases its specific gravity. It gives a frothy appearance to the filtrate and is partly the indirect cause of the high suspended solids content and high bio-chemical oxygen demand of the filtrate.

Handling Raw Sludges.—In the dewatering of raw sludge, mixtures of raw and waste activated sludges and digested sludge, the filtrate has a comparatively high suspended solid content (5,000 to 10,000 p.p.m.) and means must undoubtedly be provided for its reduction. This can take the form of an installation such as shown diagrammatically in Fig. 7, which is proposed for the Collingswood plant and after considerable research and experimental work by J. S. Pecker. Raw sludge from the primary settling tank, plus waste activated sludge from the secondary settling tank, will be piped to a thickener and skimming tank which will have a detention period of about 8 hours. This tank will be provided with decanting devices to remove supernatant liquor, skimming arms to remove the floating scum and grease and sludge scraper arms to concentrate the sludge prior to its discharge to the centrifugal clarifier. The filtrate from the centrifugal clarifier will be piped back to the thickening tank where the settleable solids will be mixed and concentrated with the sludge going to the centrifuge, the scum and grease at the surface of the thickener will be skimmed off and the supernatant liquor returned to the incoming raw sewage for subsequent treatment. Prior to the return of the centrifuge filtrate to the thickening tank either lime or chlorine will be added as it has been found that the addition of either or both of these two will assist the settling of the solids and will materially reduce the B.O.D. of the liquor returned to the raw sewage.

Handling Activated and Chemical Sludges.—In the dewatering of waste activated sludge, or chemically precipitated sludge, concentration tanks should be used ahead of the centrifugal machine. These should be equipped with decanting valves and scrapers for the thickening of the sludge and the centrifuge filtrate piped back to the thickening tank. The economy of dewatering waste-activated alone is problematical. With initial concentrations of 1.5 to 3 per cent the highest final concentration accomplished by centrifugal clarifiers at the present time is about 15 per cent. It would, therefore, appear that the economic application of centrifugal clarifiers to the dewatering of waste activated sludge is limited to installations where all of the sludge is to be digested. Therein the machines may be used to useful purpose in reducing the volume of the waste activated sludge going to the digesters. This would permit a higher concentration of solids in the digestion tank, facilitate digestion and reduce the volume of supernatant liquor returned to the sewage.

Handling Mixtures of Sewage and Garbage Sludges.—During the past several years considerable research and experimental work has been done on the dumping of ground garbage into the sewer system and the disposal of this in conjunction with the sewage sludge. Sufficient operating data are not available to determine what effect the inclusion of the garbage will have on the treatment and disposal of the combined garbage and sewage sludge. While present results indicate that this mixture can be digested, added tank capacity must be provided, greater seeding material used and proper temperatures maintained. A higher degree of control must also be used to prevent foaming in the tank.

Centrifugal dewatering and incineration of the raw mixture of garbage and sewage sludge has decidedly attractive possibilities.

[Part II of this article will appear in our next issue as the concluding installment.—*Ed.*]

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The Handbook of Applied Mathematics

(Review)

The second edition of the "Handbook of Applied Mathematics," edited by Martin E. Jansson, C.E., and published by D. Van Nostrand Co., New York City, contains 754 pages of handbook material of considerable usefulness to the practical and professional man alike.

For example, this very complete manual starts with a variety of mathematical tables, short cuts in calculations of the kind needed in practical design, computations and repair work. Then follows an illustrated chapter on mechanics and physics (gears, pulleys, levers, etc.) with typical problems stated and solved as a guide. Considerable space is devoted to water piping, plumbing and heating design in buildings, illustrating poor vs. approved design. The chapter on applied electricity, motors, wiring, electrical code specification, batteries, and the like (with the customary typical guide problems and calculations) is especially complete. Other chapters deal with construction, ordering of materials, computation of masonry and concrete work, lathing and plastering, carpentry and building, painting, plumbing and heating, sheet metal work, excavation and foundations. Here, as elsewhere, sample problems given are worked out step by step to make them clear. Still other chapters cover radio; machine shop methods; equipment and calculations; automotive shop practices; business mathematics, with interest tables, etc.; accounting and bookkeeping methods.

This second edition of the Handbook of Applied Mathematics should more correctly be named *"Everyman's Handbook";* for, between the front and back covers of this highly useful reference book of 754 pages, there is something for practically every one.

The publishers have combined two volumes into one and are offering the new and enlarged edition, on a 10 day free examination basis, for $6.00. This book can also be ordered through WATER WORKS AND SEWERAGE, 155 East 44th St., New York City.

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Chester Engineers Return to Old Firm Name

Notice has come from the engineering offices of Chester, Laboon, Campbell, Davis & Bankson, of Pittsburgh, Pa., announcing withdrawal of John F. Laboon from the firm.

The remaining members of the above firm will henceforth conduct the business under the simplified name—"The Chester Engineers"—which is essentially the same name by which the firm was known prior to reorganization about a year ago.

The retiring member, John F. Laboon, is withdrawing in order to devote his entire time to his position as Director of the Department of Highways, Bridges and Tunnels of Alleghany County, Pa., with offices in Pittsburgh.

Lexington's Monument to "Fair-Play." Famous Sire of a Famous Son, "Man-O-War"

KENTUCKY-TENNESSEE SECTION A. W. W. A. HOLDS BANNER MEETING

IN Kentucky's blue-grass surrounded city of Lexington, the home of the world's finest and fastest horses, where now lives the greatest of them all—Man O' War—and a score of Derby winners, the Kentucky-Tennessee Section of American Water Works Association held its banner meeting March 23rd, 24th and 25th.

The official registration was 114 with many more attending the Stag Dinner given by the Lexington Water Company and the dinner dance of the evening following. The afternoon of the last day was devoted to golf and a tour of the more famous of the many rich horse farms that surround the metropolis which can boast the earliest (1826) American race track, the best looking women, and the fastest horses in the world. The privilege of being just a stable-boy around such fine horseflesh would thrill this writer. And, also, to live amongst such fair ladies, as boasts the Blue-Grass State, is a combination that just can't be beaten.

F. C. Dugan Resigns

F. Clark Dugan, State Sanitary Engineer of Kentucky, who with W. S. Cramer of Lexington (a past president of A.W.W.A.), and a handful of water works superintendents organized the Kentucky-Tennessee Section and served as its secretary during the 11 years of its existence, resigned during the meeting. He was given a vote of appreciation and was presented with a handsome cocktail set. The Executive Board later announced the selection of H. D. Schmidt, Associate State Sanitary Engineer of Tennessee, as the new secretary.

L. S. Vance, Louisville, Retiring Chairman

Roy J. Morton, Nashville, Chairman-Elect

Officers named for the ensuing year are:

Chairman—Roy J. Morton, State San. Engr., Nashville, Tenn.

Vice Chairman—E. E. Jacobson, Engr., Lexington Water Co., Lexington, Ky.

Sec'y.-Treas.—H. D. Schmidt, Asso. State San. Engr., Nashville, Tenn.

Trustees—C. M. McCord, General Sup't. Water Department, Memphis, Tenn.; Hal Arnold, Sup't., Madisonville Water Works, Madisonville, Ky.

John J. Quinn, Sup't. Filtration, Knoxville, Tenn., continues as the Section's representative on the Board of Directors of A.W.W.A.

Chattanooga, Tenn. [and "Al." Porzelius, Manager, Chattanooga Water Co.] were the successful contestants for the 1937 meeting of the Section. So, to Chattanooga in 1937.

Section Takes Up Question of Operator Licensing

Amongst the resolutions passed by the Section was an important one, which came as the result of a discussion of Operator Licensing Acts as a protection to faithful and experienced Water Works Operators by Linn H. Enslow, Editor of WATER WORKS AND SEWERAGE. The resolution calls for the establishment of a committee whose duty it becomes to study the matter of Operator Licensing for Kentucky and Tennessee and reports with recommendations at the next annual meeting in Chattanooga.

Technical Sessions

(Chairman, L. S. Vance—Presiding.)

The meeting was opened with a few well chosen words of greeting and encouragement from Mrs. C. Cecil Cantrill, Commissioner and Mayor of Lexington (pro-tem) who proved a worthy pinch hitter for Mayor

Mrs. Cecil Cantrill, Lexington's Mayor (pro tem). Glad the days of toting water are gone

Fred E. Beck, General Manager, Lexington Water Company, Dinner Host — Ruled Out speeches

Reed Wilson who returned later to extend greetings at the dinner given by the Lexington Water Company.

Beekman C. Little, Sec'y., of A.W.W.A., then reported on "The State of the Association" and plead for a greater participation of Water Works Operators in the work of the Association, the securing of more managers and superintendents as members and election to the Board of Direction of A.W.W.A. of more actual operators of water works. Mr. Little also read timely excerpts from an article by Miss Jane Rider (former State Sanitary Engineer of Arizona) "On Attending Conventions."—[WATER WORKS AND SEWERAGE for May 1932.]

The opening paper was that by R. R. HARRIS, Ass't. Engineer, Kentucky Department of Health, which dealt with **"Relations of the Health Department to the Water Works Profession,"** in which he stressed the value of frankness and an attitude of partnership between water works operators and State Sanitary Engineers. In discussion, Roy J. Morton, State Sanitary Engineer of Tennessee, pointed out the value that Health Department engineers could be, and had been, in supporting water works officials attempting to secure funds for needed improvements. The highest service of the State Health Department was that of promoting knowledge (Short Schools, bulletins, meetings, etc.) assisting in emergencies, providing advisory service. And, with it all, never forgetting the partnership aspect. Mr. Morton commented that operators who hesitate to request assistance do not fully appreciate the desire and readiness of Health Department engineers to assist in connection with improvements, new projects and emergencies.

"The Construction of Small Water Systems"—J. S. WATKINS, Consulting Engineer, Lexington, Ky.

Mr. Watkins, in a thorough and masterful manner, reviewed the process of putting through a small community water system from the bond election through the preliminary survey, design, financing, construction and operation.

The importance and economy of sound engineering in selecting sources of supply and studying economics in design and layout of the system were admirably presented. Likewise, the importance of employing only experienced or trained operators and the desirability of engineer-supervision during the first 6 months' operation at least. In respect to filter performance, the washing was generally deficient and to him the surface-wash developed by Baylis in Chicago seemed to be the most economical and practical corrective that had appeared. Among others, the new Covington, Ky., plant was being equipped with surface-wash grids for use with but a 10 inch per min. vertical wash rate, the balance of the water being applied as surface wash. Also, he considered mechanical flocculating equipment possible even more important in small than in the larger plants.

Concerning pumping of small supplies; the use of large capacity pumps, with ample storage facilities in tank or reservoir and clear water well sufficient to allow periodic pumping during hours of low cost off peak power, successfully cut the major operating cost. Landscaping and beautification of water works properties paid dividends in good-will which impressed him as being more essential in small towns than in the larger communities. Attractive plants had a distinctive value to the prestige of the designing engineer as well as to the operator and the local water works authorities.

As to the costs of providing a modern small system the record of P.W.A. projects in Kentucky and Tennessee had shown a variation between $46.00 and $64.00 per capita. Costs of water treatment had varied between $5.20 and $17.00 per m.g. Interestingly, in the case of filter plants, the maximum spread in costs on a design capacity basis (including the smallest and largest), had been but $10,000—i.e., between $30,000 and $40,000 per M.G.D.

Note—In the limited space available we regret that full justice could not be done Mr. Watkins' excellent treatise.—Ed.)

HOWARD K. BELL, Consulting Engineer, Lexington, Ky., in presenting a prepared discussion, stated that in his opinion small treatment plants should not be elaborately designed for precision treatment; but, at any cost should be as flexible and fool proof as possible. The use of circular basins of steel (concrete floors) constituted economical small plant construction for filtration and storage. For improved appearances a brick veneering had served the purpose. He discussed important considerations in water supply intake design. For raw water pumping stations a mobile pump unit on a truck run out on a trestle above the river (flexible rubber suction hose) had proved to possess practical merits for flashy streams and those subject to high flood waters. Mr. Bell called attention to the new Jewell system of filtration and washing which seemed to possess distinctive merits.

L. H. ENSLOW, Editor WATER WORKS AND SEWERAGE, in commenting on the poor filter-bed condition usually prevailing in small plants, felt that there was real need for a fool-proof filter design, in which there would be no chance of bed inversion. Experiments under way at Chicago's Experimental Filter Plant involved the adaptation of a false bottom made up of hard

E. E. Jacobson, Chief Engineer, Lexington Water Co. Arranged and put over a banner meeting. They made "Jake" first Vice President

F. Clark Dugan, Resigned after 11 years as Secretary. To him went a token and vote of appreciation

The Why of Paducah's Pure Water

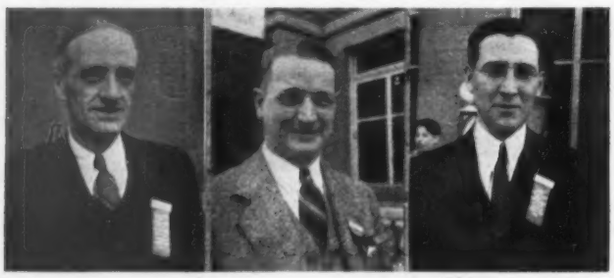
Miss Lois Sutherland says she's only the Treasurer of Paducah's Water Works—We hear, she's really the No. 1 "man." L. R. Howson, of Chicago, is Paducah's consultant of long standing. Earl Mitchell, young and capable Supt. of Filtration, likes his boss

burned porous plates, similar to but coarser grained than those used for air-diffusion in sewage treatment. The customary and troublesome layers of gravel being left out, there was no chance of bed inversion resulting from the common causes. Although more costly than the generally employed systems of filter underdrainage, the added expense could be readily justified if the tests at Chicago, Denver, Grand Rapids, Marmaroneck, N. Y., and elsewhere, proved the new design practical. In new construction the permissible reduction in the depth of filter and flow-line elevation should considerably more than offset the cost of the diffuser plate bottom—not to mention the savings in maintenance and pumping costs at the reduced head.

"Well Water Systems in Tennessee and Kentucky"—T. M. RAGSDALE, Layne Central Co., Memphis, Tenn.

In his paper, Mr. Ragsdale discussed the possibilities of water supply development involving deep wells in various geographical sections of Kentucky and Tennessee and the relative yields to be anticipated. He stressed the need for ample preliminary investigation before reaching decisions as to selection of type and location of wells and likewise, what water treatment was to be required. Above all, he stressed the indispensability of experience in putting down and developing wells, and advisability of consulting advice in the general plan, and covered briefly the modern methods and improved materials used in well construction.

C. M. MCCORD, Superintendent of Water, Memphis, Tenn., questioned by the Chair, replied that the Memphis wells were seemingly unaffected by one drought year and had a normal life of 10 to 20 years. What caused the variance in depreciation was the subject of a study under way.



Louisville's Three Horsemen

In the center is the big-boss, Jos. D. Scholtz, Pres., Louisville's City Owned, Commission Governed, Water Company. Left—W. H. Lovejoy, long-time Supt. of Filtration. Right—Clem A. Gallagher, resourceful Supt. of Meters and Services

Effect of PWA on Water Works Improvements

"The Effect of P.W.A. on Improvement in Water Works"—ROY J. MORTON, Chief Engineer, State Department of Health, Nashville, Tenn.

Mr. Morton in reviewing water supply improvements under the P.W.A. program in Tennessee stated that P.W.A. assistance plus legalization of Revenue Bond type of public utility financing had resulted in water works installations forging ahead rapidly. Especially important had been the new systems for small towns. Of considerable importance had been the necessity of building, financing and operating the new works as utilities with a minimum of political domination. Approved, at present, were 23 new systems and 6 major extensions. Mr. Morton said that a style had been set and many communities would go through with water works projects after having been too late to receive P.W.A. grant in 1935. Indirect benefits included the closer contact provided between municipalities and the State Department of Health and a better appreciation of the value of consulting engineers on small projects.

GEORGE SAGER—PWA Director for Kentucky stated

"Supers" All—And Good Ones

C. M. McCord, Memphis Water Dept.; Al F. Porzelius, Chattanooga Water Co.; W. H. Johnson, Harrodsburg (Ky.)

that under PWA 30 new Kentucky water supplies had gone in during 1933 and 1934; during 1935 only two. In approving projects now, chlorination of all well supplies was being required regardless of any assumed safety of the well. Specifications were carefully watched to insure free competition, but no review was made to check design.

"Unified Accounting for Water Utilities"—HARRY BOGGS, Hendrick and Boggs, Accountants, Indianapolis, Ind.

Mr. Boggs, in stressing the sound economy of modern improved methods of accounting, paid high compliment to the Kentucky Utilities Commission on its new requirements pertaining to public utility accounting. In this the safer accrual method of accounting, rather than the cash method, was required. He suggested that all water works adopt the improved unified system offered by the Commission and thereby learn what assets the water utility actually has and the true cost of the service rendered. It was to him as important to stop "financial leaks" as it was water leaks and likewise to have available convincing data and proof when it came to requesting funds for betterments, extensions and rate revisions.

"Water Supplies and Their Improvement by Softening"—CHAS. P. HOOVER, Consultant in Water Treatment, Columbus, O.

Mr. Hoover in his inimitable style reviewed some of the existing qualities of water in its three phases—vapor, liquid, solid. He then traced the important and historical development of public water supplies, illustrated with lantern slides. Mr. Hoover next, launched into a gen-

eral discussion of softening of water involving the basic principles and chemical reactions of the lime-soda and zeolite processes which he demonstrated. Later he discussed the selection of the proper and most economical process of softening in which he stated that the lime or lime-soda method was indicated when the water carried any appreciable turbidity. Where the water was clear the zeolite process had the advantage of lower first cost, less space required and in being subject to automatic operation. Also, when the permanent hardness (sulphates, chlorides) predominated, then the Zeolite plant operating costs became less than lime-soda.

In reply to questions, Mr. Hoover replied that the so-called soluble soaps (sulphonated oils) which lather in hard waters were too costly to be considered as a substitute for water softening. Likewise the meta-phosphate "Calgon" which had been introduced as a softening agent was too costly to be considered as a substitute. To another question: The lime-soda process was effective in reducing total hardness to 2 grains per gallon, whereas, a combination of lime-soda and zeolite in many cases proved the most flexible and economical method of securing various degrees of softening.

Advances in Water Works Practices

"Advancement in Water Works Design and Practices"—LOUIS R. HOWSON, Consulting Engineer, Chicago, Ill.

In an excellent review of trends and modern developments in water supply engineering and treatment, Mr. Howson recalled that probably the earliest adaptation of dry feeding of chemicals was accomplished with a home-made feeder built at the Paducah, Ky., filtration plant in 1904. The present day demand in dry feeding devices was for the newer gravimetric control which involved feeding by weight, rather than by volume. Handling and storage of chemicals had been materially simplified, made more economical and essentially dustless, by adaptation of air-veyor equipment for handling bulk chemicals from car to bins to feeder hoppers. Real savings in cost of chemicals had resulted.

In the highly important matter of efficient preparation of raw waters a marked stride had been made in improved coagulation, economy of chemicals, reduced filter loadings, longer runs, and a more consistent and higher quality of effluents. Such had been accomplished by adaptation of flexible mechanical mixing and flocculating devices, involving rapid distribution of chemical followed by slow mechanical agitation to agglomerate floc particles into quick settling masses. The horizontal-shaft "flocculator," developed at the Richmond, Va., plant, had proved its worth and since had been adopted by several important plants. Along with gravimetric feeders and air-veyor equipment it had been incorporated in the new Milwaukee plant.

In filter bed cleansing the high-velocity wash had not solved the mudball and hard spot problem. What appeared to be the most practical scheme proved to date was the Baylis lateral surface sand wash provided through a pipe grid suspended in the upper sand. A low rate upward wash just sufficient to liquefy the sand bed allowed the lateral jets to scour the dirty upper sand free of sticky accumulations. Developed by Baylis at the Chicago Experimental Filter Plant, the system had proven so effective at Kenosha and Racine that it had been included in the Milwaukee plant. The cost had been nominal at $200 per mg. plant capacity. (The new plant at Covington, Ky., designed by J. S. Watkins of Lexington, is likewise being equipped—Ed.) Mr. Howson also called attention to a system of surface sand wash and subsurface filtration recently developed and patented by Ira M. Jewell of Chicago.

A. P. Learned, Black & Veatch, Engrs., Kansas City, Mo.; J. S. Watson, Lexington, Consulting Engineer; W. J. Eldridge, Du Pont's Chemist, Old Hickory, Tenn.

H. D. Schmidt, Tenn. Dept. of Health, Nashville (New Secretary of the Section); R. R. Harris, Ky. Dept. of Health, Louisville; Martin Flentje, Community's Supt. Purification, at home in Lexington or Greensburg, Pa.

In taste and odor control Mr. Howson warned against attempting to cut corners and save a few dollars at the expense of consumer good-will, if not a change of plant management and operating force. Consumers were not interested in alibis or explanations and therefore frequent testing at the plant for signs of taste or odor occurrence was cheap insurance at whatever it cost. When realizing that the cost of applying powdered carbon to 250,000 gals. of water was not more than the price of a 5 gal. bottle of spring water, there seemed to be ample justification for its usage to avoid even minor tates. Not minimizing the value of taste prevention measures, such as coppering and ammonia-chlorine treatment, none the less activated carbon was the most successful and immediate cure available and its continuous use was justified where sporadic bad tastes, or even off-tastes, were encountered. To his mind sterility and palatability could not be over-stressed as primary considerations in water supply practice. Alibis for foul tastes were rapidly failing to satisfy the public and hardly excusable with modern methods now available.

In administration, management and operation, the Commission form of management had proved its merits in combining the good features of both public and private management. The high calibre of members of Water Works Commissions had made for sound financing and business-like management and operation. Efficiency in meterization practices had been on the increase as had the resultant water. It was his opinion that at least 50 per cent of the unaccounted for water could be accounted for by running down defective or tampered with meters.

Picturizing the effectiveness of modern plant beautification by slides, Mr. Howson recited several instances in proof that beautification was not alone impressive in the public's eye but had also loosened their pocket-book strings. Plant beautification was plainly "good-business" in public as well as privately operated utilities. And, better operation was a by-product resulting from pride.

A. P. LEARNED, Black & Veatch, Engrs., Kansas City, Mo., in vivid discussion, considered the engineer's major function to be that of assembling and adapting the best in available methods and equipment to their most effective use technically and economically. It was his job to keep abreast of improvements and evaluate such before designing and assembling a plant. Thereafter it was the operator's duty to make the best use of modern methods and equipment; to better their qualifications and keep abreast by attending short-schools, by study and reading those leading technical magazines which had been so markedly improved in recent years. Security of position and advancement would automatically come to the operator who takes his work seriously. The world would soon know about *him*. Operators attending meetings should not be afraid to ask questions of any and all who might help them. The younger generation had less fears than the older and learned much by asking questions. An operator could likely gain locally by cultivating the high school chemistry teacher. Get him interested in the water treatment plant and do not hesitate to ask his advice. Suggested, Mr. Learned; you may be surprised at his genuine interest and help in your problems, not to mention the good that comes from publicizing the plant through teachers and the younger and impressionable generation.

(1) Gerry Kavanagh, Wallace & Tiernan Co., Knoxville; (2) Miss Cooper, Lexington's Water Co.; (3) H. N. "Half-Pint" Jernigan, Wallace & Tiernan Co., Lexington, who helped "Jake" put over the "Show"; (4) Clark Cramer, Lexington Water Company's Supt. Filtration; (5) John Quinn, Knoxville's Supt. Filtration and Director of A. W. W. A.; (6) Beekman Little, Secy. of A. W. W. A., but Miss Cooper collected his registration fee just the same.

"Improvements in Coagulation"—W. J. ELDRIDGE, Chemical Engineer, Du Pont Rayon Company, Old Hickory, Tenn.

Mr. Eldridge recounted experiences at the Old Hickory plant in improving water treatment to produce the high quality of supply requisite in Rayon production. Chief amongst these improvements had been the mechanical flocculating equipment supplied by the Dorr Co. and supplemented by the lateral mechanism for frequent automatic sludge removal from the basins. Marked had been the greater uniformity of chemical control in treating waters of changing qualities, turbidity and alkalinity. The effect of the 40 minutes of mechanical flocculation following the rapid short mix had been to eliminate the careful adjustment of pH and the bothersome effects of temperature changes on coagulation. The result was a less exacting chemical control and dependability on plant performance, not to overlook the incidental saving during the past year of 23½ per cent of the chemical cost and value of the wash water saved. The use of artificial alkalinity (soda ash) had since been discontinued and it looked now as if a 33 per cent saving in coagulant would likely result in 1936. The success of the first unit had justified equipping the whole plant. Speed variations on the horizontal paddles were varied between 1.4 and 3.7 r.p.m. to suit changing conditions as indicated by flocculation tests with the laboratory stirring equipment pictured on the screen. He also described and pictured equipment used to determine as little as 1/100th of a part of turbidity.

With the flocculators a 65 min. settling basin period semed to be ample, if position of mud deposits and turbidity of the applied water was a criterion. Especially interesting was the fact that 40 minutes of basin capacity could be given over to the flocculating equipment and still have more than ample settling capacity remaining.

W. M. LOVEJOY, Sup't Filtration, Louisville, Ky., basing his remarks on experiences with the Louisville flocculators, stressed the value of initial chemical distribution by the rapid mix, which could not be compensated for in the succeeding flocculating stage. The effect of suspended floc recirculation by horizontal paddle rotation was also not to be overlooked, the Louisville flocculators producing best results at a blade (peripheral) speed of 60 ft. per min. In addition to cleaner filter beds and longer runs an average 20 per cent reduction in chemical cost had been credited. The principal difficulty had been the piling up of sludge just beyond the flocculators resulting in a deposition of 80 per cent of the sludge on 40 per cent of the basin floor. As to costs, maintenance had averaged 4 cents per mg. ($150.00 yr.) whereas the definite savings ($5,000 per year for coagulant) would pay for the installation in 3 years. Additional items of economy in filter maintenance and operation were difficult to evaluate, but had been none the less appreciable. Mechanical treatment had largely negatived the previous importance of refinements in chemical control.

"Aeration, Odor and Carbon Dioxide Removal"—MARTIN E. FLENTJE, Sup't of Purification, Community Water Service Company, Greensburg, Pa.

Mr. Flentje discussed the performance of various types of aeration devices and quoted their efficiencies. For odor removal it seemed that diffused air in fine bubbles was the most effective process whereas a riffle aerator reduced odors about 25 per cent only. For carbon-dioxide displacement the spray nozzle type produced 75 to 90 per cent removal; cake trays in tiers (rate 20 to 50 g.p.m./sq.ft. surface) 50 to 80 per cent; riffle and cascade types 40 to 45 per cent; diffused air (15 min. period) 75 per cent or better.

In emergencies diffused air was the easiest and quickest to apply; required only 1 K.W. power per m.g. for 15 minutes of aeration; could be used in conjunction with coagulation. Spray type aerators had the disadvantage of raising dissolved oxygen content (increased corrosion); also, spray blowing nuisance and evaporation.

L. H. ENSLOW told of his experiences while in Panama in developing a step type aerator in which the treads were sloped sharply backwards to the riser. This caused the falling water to rebound upward and much of it to

fall back to the same step before dropping to the next lower one. Thereby the result was in effect a double aeration of a considerable part of the water. The higher the rate down this "leaping-step" aerator, the more efficient was the turbulence and the aeration effect. It proved a marvelous flash mixing device and coagulant economizer.

Meter Maintenance

"Meters, Maintenance and Installation"—CLEM A. GALLAGHER, Sup't of Meters and Services, Louisville (Ky.) Water Co.

Mr. Gallagher recounted experiences and practices developed in Louisville resulting from a detailed and exhaustive program of meter replacements, testing and repairs. The average cost of 50 cents per meter for changing, overhauling and double testing, and some meters now 40 years old had been overhauled and returned to service.

(Elsewhere in this issue Mr. Gallagher's enlightening and stimulating paper appears in full.—Ed.)

C. M. MCCORD, General Sup't, Water Department, Memphis, Tenn., in discussion, said that the Louisville meter maintenance recording system was the most thorough he had been privileged to know about and Mr. Gallagher's department was doing a bang-up job in the field and shop. In Memphis the use of acid for meter cleaning had also been discarded in favor of soap and water. The copper carbonate coating was not removed but Bon-Ami powder was placed in the meter and disc rotated to smooth the coating. In preparation for an extensive meter survey as a WPA project, a field test set had been developed for accuracy measurement and determination of minimum flow required to operate each meter. It had been found that ¼ pint per minute would not be registered by most meters and the estimated loss of revenue for non-registered water leakage through meters would amount to approximately $25,000 per month in Memphis.

In closing, Mr. McCord again complimented Louisville on the efficiency of its meter shop but had to admit that Memphis went Louisville one better in the type of bench cover. A meter part if dropped on the battleship-linoleum bench tops in the Memphis shop bounced right back into the workman's hand—and now Louisville had only to replace its metal bench covering to come up to Memphis shop efficiency. (Laughter.)

(Note—Mr. McCord will describe and demonstrate the special field test outfit above referred to, before the Los Angeles Convention of A. W. W. A. on June 11th.—Ed.)

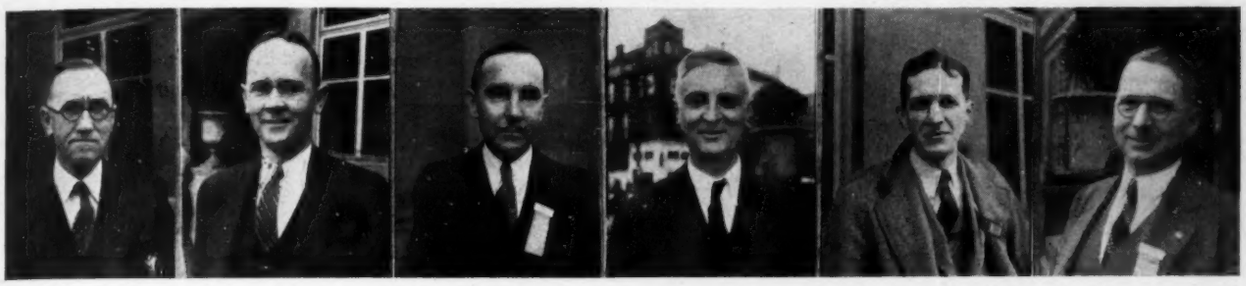
"Hazards of Cross Connections and Their Elimination"—A. H. FLETCHER, Sanitary Engineer, Department of Health, Memphis, Tenn.

Mr. Fletcher outlined the routine survey, sampling and testing which practiced in checking up the 48 private or quasi-public potable water supplies which maintained a connection with the Memphis public supply. All of this was covered by a city ordinance regulating cross-connections and enforced by the Health Department. Cross connections with unapproved supplies were not allowed in any form. Plumbing fixture hazards were the next type of cross connection to be dealt with.

Round Table Topics

W. G. STROMQUIST, TVA Sanitary Engineer of Knoxville, Tenn., in speaking on "Malaria Control," outlined ways and means of preventing mosquito breeding in reservoirs which involved fluctuating water level, clean shore lines, stocking with top-minnows and holding down protective aquatic growths.

In discussing **"Problems of the Small Plant Operator,"** W. H. JOHNSON, Sup't of Harrodsburg (Ky.) Water Company, recounted his experience with faked meter reading on stopped meters and loss of revenue of $386 per month thereby. Taste and odor control, once a serious problem, had not been since the use of "Nuchar" at Harrodsburg. To overcome political changes he recommended cultivating the women's clubs. Further, he had found that Mrs. Johnson's local activities had been a material asset in good-will building and thereby security against political upsets. Mr. Johnson warned against political activity, against talking too much about troubles; was justly proud of the fact that with proper meter maintenance only 4.93 per cent of the water pumped could today not be accounted for.



(1) H. K. Bell, Cons. Engr., Lexington; (2) A. H. Fletcher, San. Engr., Memphis; (3) Hall Arnold, Supt., Madisonville, Ky.; (4) W. G. Stromquist, TVA's Sanitary Engr., Knoxville; (5) T. M. Ragsdale, Engr., Layne Central Co., Memphis; (6) Robt. C. Terrell, Supt. of Danville, Ky.

"Methods and Value of Plant Beautification" were recounted by HALL ARNOLD, Sup't., of the Madisonville (Ky.) Water Company who operates a highly attractive plant and appreciates the value of beautification in the eyes of the public. Put through as a W.P.A. project, beautification could be had with but little cost.

"Advances in the Use of Carbon Ammonia and Chlorine" were briefly covered by F. E. STUART, lately directing water treatment activities of the recently organized Activated Alum Corporation of New York City. He stressed the economy of application of carbon to filters in batch form after washing and suggested the use of some carbon continuously to the raw water to improve coagulation and keep the basins and filters in aseptic condition; to stop leakage of tastes through the plant. In prechlorination he warned against carrying residual chlorine into the filters if taste production was to be avoided within the beds when algae are present. In ammonia-chlorine treatment the latest innovation involved the scheme of adding the chlorine *first* and thereafter the ammonia in ratio, required to convert only the residual chlorine to chloramines. This scheme had been very effective in speeding sterilization and was productive of economy in ammonia. In Lon-

don a combination of copper sulphate and ammonia-chlorine applied to the raw water along with the coagulant had been shown to possess distinct advantages and net economy. For control of water-fleas, prechlorination had been effective in stunning the animals, to a degree that they became helpless to emerge from the drag-down of the alum floc.

"Handling and Feeding of Carbon, Ammonia and Chlorine"—GERRY KAVANAGH, Sales Engineer, Wallace and Tiernan Company, Knoxville, Tenn.

Mr. Kavanagh called attention to the valuable paper by L. L. Hedgepeth, Technical Service Director, Pennsylvania Salt Company, on chlorine handling, which appeared in the November 1934 issue of the Journal of A.W.W.A.

Mr. Kavanagh said that re-liquefaction of chlorine in the gas limes to chlorinators had been a source of considerable annoyance to operator. Methods of prevention, such as those employed at Richmond, Va., and elsewhere, had been successful—i.e., reducing gas pressure on the line and sloping of limes to driplegs at low points. (See WATER WORKS AND SEWERAGE, February 1936—"Practical Aspects of Chlorine Handling"—C. F. Bingham.)

Mr. Kavanagh called attention to improvements to dry-feeders to preclude dust nuisance and damage, incorporating a completely enclosed motor drive with Alemite grease fittings and dust control features. He also listed improvements made to chlorinating equipment, including protective automatic shut-off valves operating in case of chlorine leaks, also the remote control of chlorinators and ammoniators. In ammonia chlorine treatment reversing the sequence of application to secure quick action of chlorine followed by fixing of residual with ammonia had distinctive advantages where permissible.

L. H. ENSLOW, Eng., The Chemical Institute, N. Y. City, explained the reasons for favoring the addition of chlorine prior to ammonia. Especially was this system efficient and economical for well waters and clean surface water. For quick sterilization a high chlorine dosage without ammonia could be applied to the well direct; on leaving the pumping station ammonia added rendered the residual chlorine unobjectionable to consumers, prevented bacterial growths and resulting degradation, the solution of iron (corrosion) and tastes in dead ends. Likewise in small gravity systems "chlorine cocktails" before breakfast could be eliminated with ammonia as the "antidote" for chlorinous tastes due to high residuals. The scheme might be considered super chlorination followed by residual chlorine inhibition with ammonia as contrasted to dechlorination. One warning note in connection with surface waters was necessary—i.e., the possibility of setting up a by-product taste which ammonia following chlorination could not eliminate. Residual chlorine going into dirty mains, containing slime deposits, would produce the same effect; therefore, before and during the first week or 10 days of ammonia-chlorine treatment old deposits in mains should be flushed out in as thorough manner as practicable. The chloramine would kill growths and loosen slime which flushing alone fails to remove. Clean mains and sterile dead ends had been proven of more importance in taste control than ordinarily considered—especially so under putrefactive summer conditions.

"On Making Friends With Customers"—AL. F. PORZELIUS, Manager, Chattanooga (Tenn.) Water Co.

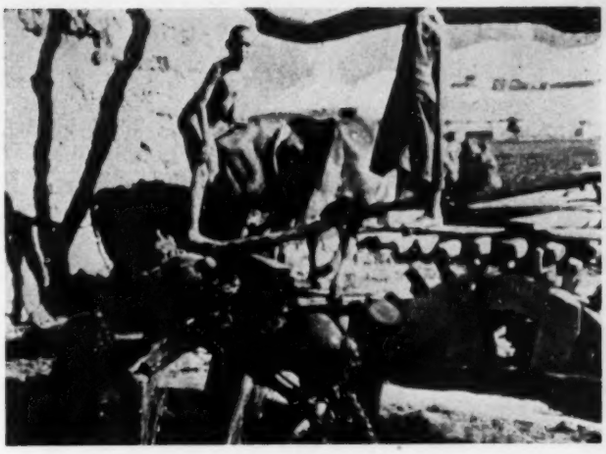
Mr. Porzelius said that one of the best means of making friends of customers was to treat them as friends; to keep them as friends, produce a high quality product at any cost and at all times. Pleasant voices on the utility's end of complaint or inquiry 'phone calls had proved its worth and contact with the manager should not be made too difficult to the ruffled customer. To the inquisitive onlooker the foreman in charge of main or service repairs should be paid as much for courtesy to the curious as for his ability as a workman. More than ever was customer good-will an indispensable asset of the utility and that applied to public as well as private ownership. Close contact with civic-organization was always a help and as Mr. Johnson had already said a diplomatic streak in the manager and his wife was always telling. Make the public realize that pure water delivered to the second floor at 5 cents and less per ton was a lot for the money, when considering that a ton of dirt in the back yard cost many times more. He, Porzelius, had found that a personal letter from the manager, welcoming every new customer to the community, and assuring them of the best possible service, was an effective introduction to happy relations. Methods of making it pleasant to step up to the cashier's window (no bars) was cheap at any cost and "change with a smile" was money in pocket.

Manufacturers' Representatives—Nee, Peddlers

(1) *"Matt" Collins (Rensselaer Sales Mgr.)*; (2) *Howard Stillwell (Leadite)*; (3) *Brownie Brown (Water Main Cleaning Co.)*; (4) *H. A. Perkerson (M & H Valves, also Convention Sirens)*; (5) *Ben Crabbe (McWane Pipe)*; (6) *C. R. Bird (Pitometer Co.'s Distr. Mgr.)*; (7) *"Bill" Lyman (National Cast Iron Pipe's Southern Sales Manager*

"Algae and Its Control," scheduled to be discussed by CLARK CRAMER, Supt. of Filtration and Pumping, Lexington Water Company, was changed to a showing of the now famous film revealing the life habits of many forms of fresh water biology, which was loaned Mr. Cramer by Major John Hawley of Fort Worth, Tex. At the request of Mr. Cramer, Harry A. Faber of The Chlorine Institute, already familiar with the film, made the running explanatory remarks based on the descriptive manuscript by Major Hawley.

At the close of the session, Mr. Duggan showed moving pictures borrowed from the Chicago Department of Health, which illustrated safe and unsafe types of plumbing fixtures through which back syphonage of pollution could occur into the water supply pipe system.



"Modern" Water Pumping in Egypt for Irrigation Along the Nile. The Egyptian "Sakleah" (Water-Wheel) Was Introduced Into Egypt by the Romans About 300 B. C. (The above picture was enlarged from a moving picture film taken by John R. Downes.)

N. J. SEWAGE WKS. ASSOCIATION CELEBRATES TWENTY-ONE YEARS OF SERVICE

WITH its 21st Annual Meeting at Trenton, N. J., March 19th and 20th, the New Jersey Sewage Works Association observed its "coming of age." The founding of this association on January 28, 1916, gives it the distinction of being the oldest organization of its kind in America.

Early in the meeting, Dr. J. Lynn Mahaffey, Director, N. J. Department of Health, on behalf of the members, presented to the past-presidents attractive tokens of esteem and appreciation, consisting of unique watch-chain keys bearing the emblem of the Association.

Those who have served in this office for two years each, and in the order listed, are:

*John R. Downes, Bound Brook.
**Paul Mollitor, Chatham.
I. Z. Collings, Collingswood
C. G. Wigley, Atlantic City
S. Fisher Miller, New York City
J. H. Coe, Englewood
P. N. Daniels, Trenton
Edw. F. Shissler, Haddon Heights
Floyd A. Hoffman, Morristown
Courtland H. Shute, Glassboro
Willard C. Mallalieu, Boonton

*Long time "Main-Spring" of the Association and veteran secretary.
**The "Dean of Sewage Works Operators" and Dad of two of the wheel-horse officers of the Association.—Ed. and Paul, Jr.

Edw. F. Schissler, Haddon Heights, N. J., Past President and Chairman of Comm. on Licensing Laws.

J. B. Baty, Asst. Engr., State Dept. of Health, Had Much to Do with Licensing Standards.

Licensing Acts Revised

Before the business session the committee on Sewerage Termnology, at work on definitions and explanatory terms applied in sewerage and sewage treatment, presented a progress report which listed a number of definitions already established. As far as practicable definitions in the existing Sewerage Termnology of the American Society of Civil Engineers will be adopted and its work should be completed before the 1937 meeting.

Following the reports of the Secretary and Treasurer came one of primary interest—that of the Committee on Revision of New Jersey Operator Licensing Laws which was presented by Edward F. Shissler as its chairman. In the work of this committee the New Jersey Water Works Association was also represented and the outcome is a supplement (Assembly 125) to the existing 1918 law pertaining to sewage works operators which includes water works operators in charge of systems and/or purification plants. Excluded are employes of privately owned systems. A separate bill (Assembly 124) has been drawn for the purpose of insuring tenure of office by licensed managers or others in responsible charge of operations of both water and sewage systems. The new bill calls for a license fee of $3.00 to $5.00 to cover the annual renewal of licenses. Neither bill has yet been reported out of the Assembly Committee and therefore the Association passed a resolution unanimously endorsing both bills (A 124 and A 125) and calling on the Assembly Committee for their speedy handling.

These new and revised bills were drawn with the assistance and participation of the South Jersey Association of Water Superintendents, The New Jersey Water Works Association and the South Jersey Sewage Operators' Association. In addition to Mr. Shissler, P. N. Daniels and Chas. A. Capen, Jr., constituted the representatives of the New Jersey Sewage Works Association and the trio were tendered a deserved vote of appreciation.

New Officers

The Nominating Committee reported the following officers for the ensuing year:

President—Edward P. Hyland, Moorestown, N. J.
Vice-Pres.—Edward P. Molitor, Springfield, N. J.

Edw. P. Hyland, Supt. Water and Sewerage, Moorestown, N. J., President-Elect.

W. C. Mallalieu, Supt. Boonton (N. J.) Sewage Works, Retiring President.

Vice-Pres.—Samuel Probosco, Burlington, N. J.
Sec'y.—John R. Downes, Bound Brook, N. J.
Treas.—Paul Molitor, Jr., Morristown, N. J.

Technical Sessions

(Pres. W. C. Mallalieu—Presiding.)

"The Composition of Sewer Atmosphere as Affecting the Sewage"—L. R. SETTER, Div. of Water and Sewage Research, Rutgers Univ., New Brunswick, N. J.

Mr. Setter reported on a study made to determine the effect of the atmosphere within sewers and sewer ventilation on the quality of sewages. Field and laboratory analyses (48) made of sewer atmosphere at and between manholes on two systems (principally domestic) revealed the presence (average) of 0.414 per cent CO_2 and 19.9 per cent Oxygen. Gas extracted from the sewage proved to be on the average, 70.9 per cent CO_2 and 0.26 per cent Oxygen. The rates of oxygen depletion, even at 20 deg. C., was more than twice the rate of oxygen absorption (1 p.p.m. per hour) from the sewer air. Mr. Setter believed that creating turbulent flows in sewers would keep the sewage fresh in warm weather with the oxygen available, and this, even in moderately well ventilated sewers. In winter the rate of oxygen depletion was considerably less than the rate of solution.

"Operation of the Perth Amboy (N. J.) Plant"—L. P. Booz, City Engr., Perth Amboy, N. J.

Mr. Booz explained that the highly industrialized nature of the sewage of Perth Amboy was one of the main considerations which led to the construction of a chemical precipitation plant equipped with Laughlin Magnetite Filters. Experience had now shown the justification for the selection. Since the industry of the city paid 30 per cent of the taxes, it seemed logical to operate a plant capable of handling the industrial load and not force industry, as others had, to cease using the Municipal sewers. Another consideration was the compactness of the chemical plant and scarcity and cost of land area. A third was the non-necessity of using chemicals during the winter period.

After 6 months of summer operation the following cost figures could be presented. With full chemical treatment in August and July the cost had been $39.00 per m.g. against $25.34 per m.g. in January when sedimentation and vacuum filtration of sludge was the process. These costs included the operation of two lift stations and re-pumpage of the whole flow at the treatment works. The sludge cake had been disposed of on park areas without odor nuisance. The whole project had cost $915,000—30 per cent coming from P.W.A.

In reply to questions, Mr. Booz said that the treatment plant fully equipped had cost $350,000. The treatment costs quoted included all labor costs of which there was admittedly a great abundance. (It seems that Perth Amboy and Chicago have something in common. Both take note: Atlanta brings down the City Chain Gang and keeps treatment costs down.—Ed.)

To another question: Loss of Magnetite ore (filter material) seemed very slight—about 5 per cent per year he would judge. The filters really did a credible job, and particularly so during heavy flow periods.

"The Raritan Bay Survey"—ARTHUR P. MILLER, San. Engr., U.S.P.H.S., New York City.

Through the use of maps, Mr. Miller described the pollutional studies of the Raritan Bay looking into the extent of pollution of beach and oyster bed areas, the effect by winds, tides and currents. The survey had involved analyses of hundreds of water samples under a variety of conditions in which the States of New York and New Jersey had cooperated with the Public Health Service.

DR. J. LYNN MAHAFFEY, Director, N. J. Department of Health, was very complimentary of the survey work which had resulted in spotting pollution and getting some prompt corrections. Another result—a comprehensive program of correction for the whole area now under way. In permitting the approval of 20,000 acres of oyster beds and re-employment of 725 people, the survey had, furthermore, been of economic importance.

"Discussion on Plant Operation"—C. M. NICHOLS, Assistant Engineer, N. J. Department of Health, Trenton, N. J.

Mr. Nichols reviewed the many problems of the non-technical sewage plant operator and by slides picturized his talk which covered such matters as the accuracies of various type weirs, economical use of different pumping rates, treatment of foaming tanks, explosion and gas hazards, equipment and practices recommended by the Health Department. He explained routine plant tests such as pH, B.O.D., relative stability, residual chlorine. In the last he suggested that in order to insure against error created by nitrites that a test be made with potassium iodide and starch. If blue, then apply to another portion the orthotolidin test for a quantitative measure. A positive test with orthotolidin and absence of blue color in the starch iodide test (without acid) would prove the orthotolidin test color erroneous and due to nitrites rather than chlorine.

"Sewage Sludge for Developing Golf Turf"—NORMAN L. MATTICE, Canoe Brook Country Club, Summit, N. J.

For five years Mr. Mattice had used sewage sludge on greens and fairways with great satisfaction. Especially pleasing had been the reduced weeding costs—$2,600 cut to $400 since substituting sludge for stable manure. The only deficiency as a grass producer seemed

Paul Molitor, Jr., Supt. Sewerage, Morristown, N. J., Efficient Treasurer.

John R. Downes, First President; Secretary Ever Since; 21 Years of Service.

Weston Gavett, Consulting Engr., New York City; L. P. Booz, City Engr., Perth Amboy, N. J.; Dr. W. Rudolfs, Sewage Expert, New Brunswick, N. J.

to be the phosphate and potash (5 per cent N.; 2.5 per cent Phosphoric Acid; 1.5 per cent Potash) and this had been made up with commercial fertilizer. Top dressing soil had been prepared by placing a 6 inch layer of sludge on 1/5 acre of land in the fall which was plowed under in the spring and planted to cow-peas. The rank pea growth (2 months) was also plowed under. A four inch layer of sludge on the same area was plowed under, planted to rye for a winter cover and plowed under in the spring to produce excellent top dressing soil. To combat greens diseases the cost was $1,000 before and $600 since using sludge. Further, the greens held moisture better, stayed green longer.

In answer to questions: The sludge was a mixture of crude solids and activated sludge—(air-dried) which he thought should be applied in the fall for best results. The cost of spreading had been roughly $5.50 per ton.

"Notes on Experimental Works of the N. J. Sewage Experimental Station"—DR. WILLIAM RUDOLFS, Director, New Brunswick, N. J.

Amongst other items, Dr. Rudolfs' pointed to the need of more laboratory and plant study looking to the better understanding and control of the activated sludge process. So far, their studies had shown sewage colloids and active sludge floc to be negatively charged and that clarification was affected by the base exchange properties of the sludge.

Further, the capacity of settling was not in proportion to the coagulating power of activated sludge and too bulky floc (well coagulated) produced buoyant masses and a form of "bulking." On the other hand there was a direct relationship between coagulating and purifying ability of the sludge. In control of return sludge the ratio to sewage flow should be placed on a suspended solids basis (sludge to crude sewage) for the best effects. The established volume ratio had no scientific reason behind it.

In chemical precipitation, two important factors had been observed. The highest clarification with iron salts occurred in two narrow zones of pH—on the acid size at pH 3.0 to 3.5; on the alkaline at pH 9.5 to 11.0. The second was that turbidity determinations in plant practice (influent vs effluent) is a reliable indicator of suspended solids removal and purification in most every case.

Reporting on their chlorination studies (about to be published) Dr. Rudolfs stated that an *actual* B.O.D. reduction by chlorination, to the extent of 2.4 p.p.m. (average) for each p.p.m. of chlorine added, had been definitely established. More interesting; when partial chlorination was practiced the actual B.O.D. reduction per unit of chlorine were greater. The first chlorine applied accomplished the greatest amount of effective work in changing putrescible compounds to stable ones and each p.p.m. chlorine had thus reduced B.O.D. values by 5.4 p.p.m. Further, the marked importance and economy of rapid efficient distribution of chlorine in the sewage had been established in B.O.D. reduction as well as biological efficiency.

H. W. GEHM, staff member who had conducted most of the chlorination studies, was called to his feet by Dr. Rudolfs to "carry on." He displayed graphs showing that more than 70 per cent of the total reductions took effect within 15 seconds of contact. The chlorine demand of fresh sewages was shown to be equally divided between three phases; viz., coarse solids, finely divided solids (pseudo colloids), and material in solution—practically 33 per cent of the total demand being exhibited by each.

Men Along the Nile

The technical session on the second day opened with a highly interesting and well photographed movie by John R. Downes—"Men Along the Nile"—which he made during his trip abroad through Egypt and far up the Nile beyond the great Assuam Dam. Of considerable interest was the archaic method of lifting water from the Nile for irrigation needs—a system but little improved since about 300 B. C. when the invading Roman armies introduced the ox and man driven water lift wheel—"Sakleahs."

"Painting Sewage Works Structures"—DR. A. F. PISTOR, Inertol Company, New York City.

This paper, ready by Mr. Vostrand, of the Inertol Company, constituted an exposition of the basic formulas for protective coatings involving bituminous and synthetic resin bases. Specific recommendations were made concerning cleansing of surfaces as an all important preliminary. For concrete protection, 3 coats of coal tar base paint was recommended; for submerged metal parts, 2 coats of coal-tar enamel plus one coat of resin base paint; for super-structures, gratings, etc., and interior equipment, synthetic resin enamels now available in all colors. Only for milder conditions were oil paints and aluminum paints satisfactory, according to Dr. Pistor.

In reply to questions, Dr. Pistor said that aluminum paint was resistant to mild acids but not to alkalis. Synthetic resinous enamels were now made which would not change in structure to check or crack under the sun. Yes, light colors and blues fade but not the darker colors. For tank interiors, holding iron salt solutions such as ferric-chloride, he would suggest a heavy synthetic enamel plastic applied 1/16 inches thick and a coat of clear lacquer.

Chemical Treatment

"Comments on the Chemical Treatment of Sewage"—WESTON GAVETT, Associate Engineer, Clyde Potts, Engrs., New York City.

Mr. Gavett said in effect that water treatment men would take naturally to chemical precipitation methods

Jim Potter, Service Engr., Pa. Salt Mfg. Co.; Raymond Case, Supt. Sewage, Merchantsville, N. J.; A. E. Griffin, Chemist, Wallace & Tiernan Co., Newark, N. J.

Wellington Donaldson, Engr. Sewage Treatment, New York City; Harry Freeburn, District Engr., Pa. Dept. Health, Philadelphia, Pa.; L. R. Settler, N. J. Experimental Station, New Brunswick, N. J.

of sewage treatment because of a feeling of familiarity. In discussing some of the newer aspects of chemical treatment, he pointed to the economy of automatic chemical control even at high first cost. By use of the telechron clock and a cam arrangement the rate in lbs. per m.g. of chemicals was being varied for different hours of the day, i.e., up and down with the rise and fall of sewage strength. This was in addition to the Chronoflo for automatic control of the weight per hour to keep pace with changing volume of flow. This combination, in one plant under his supervision, provided for the additive demand for dosage increase with strength increase plus the increase with flow increase and thus took care of these two important variables to minimize the waste of chemicals or the failure in coagulation efficiency.

Concerning the relationship between quality of sewage and chemical requirements, Mr. Gavett advanced the idea that the coefficient of fineness of suspended matter (suspended solids divided by turbidity) was an important element in the matter of chemical demand for clarification of sewages as it is for water.

Mr. Gavett laid some emphasis on the thoroughness of mixing and flocculation in chemical precipitation. Concerning coagulants, he said, that the use of alum in some sewages seemed preferable to the iron salts—especially when the solids were in a fine state of division such as occurs in septic or stale sewages and many industrial wastes. He felt that chemical treatment, after the burst of many claims by its advocates, was settling down to normalcy. Especially was it attractive as a means of increasing the effective capacity of existing plants, seasonally or continuously. To illustrate relative costs, Mr. Gavett's display of graphs showed the definite and important place that intermediate treatment (chemical precipitation) fills in the array of treatment processes.

In answer to Dr. Rudolfs' questions: Mr. Gavett said that a dosage of 600 lbs. of alum per m.g. had given excellent clarification at Lakewood, N. J. The B.O.D. reduction had been 60 per cent and chlorination was thereby indicated. No comparison had been made with ferric-chloride or other iron salts. The alum floc once formed could not stand rough handling or turbulence. There was a tendency for the alum floc to settle slowly although it had not actually floated. To the weak night sewage (mostly water) no coagulant was to be added, sedimentation and chlorination being sufficient.

"Operating Kinks in Chemical Treatment"—A. E. GRIFFIN, Chemist, Wallace and Tiernan Company, Newark, N. J.

Mr. Griffin commented that the great majority of sewage works had found it expedient to utilize some form of chemical in one manner or another. He would not attempt to discuss the merits or limitations of chemical methods of sewage treatment because there was little to add to the excellent report of the A.P.H.A. Committee "Chemical Treatment of Sewage" which had appeared in the Sewage Works Journal of November 1935. (To the reader who has not a copy of this authoritative report, reprints are available through the New York office of WATER WORKS AND SEWERAGE. They will be sent gratis as long as the supply lasts. —Ed.)

Mr. Griffin said that a trick in changing chlorine cylinders without machine shut down comprised connecting to the manifold fresh cylinders before those in use were exhausted. The partly empty cylinders would completely empty far ahead of the least used cylinders and the change could be made without loss of chlorine or shut down. After awhile fresh cylinders connected where the empties were removed completed the cycle. Where two chlorinators were available the scheme possessed no merit.

When a white fog (smoke) appeared at the point of discharge of chlorine into sewage, it indicated a waste of chlorine and formation of ammonium chloride. To correct the condition a better hose submergence or a more efficient distributor was the remedy. Direct feed chlorinators and solution machines which sucked in air through the injector were particularly bad fog producers.

In adding lime, chlorine or ferrous chloride to sewage to reduce odors the lime formed the highly ionized soluble hydrous sulphide subject to subsequent breakdown. Chlorine destroyed hydrogen sulphide and precipitated sulphur, whereas the iron salt made relatively insoluble ferrous sulphide which only a strong acid would break down. In chemical precipitation iron salts at lowering pH values produce very complex precipitates which are bulky and highly adsorptive and to economize in iron requirement carbon dioxide (stack-gas) is blown through the sewage at Atlanta to lower pH value.

Adding iron salts up sewer had not proved an effective method in chemical precipitation because where tried the floc became disintegrated during its travel through the sewer and had to be gathered together

(1) *Ellis Phelps (Pardee Eng. Co.)*; (2) *John H. Mount, Chief Operator, Atlantic Highlands;* (3) *E. M. White, Supt. Sewerage, Red Bank;* (4) *H. S. Allen, Sewerage Commissioner, Red Bank;* (5) *A. F. Brendlin (Filtration Equipment Corp.)*; (6) *"Bart" Marshall (Chain Belt Company), Mgr. Sanitary District Div.*

again at the treatment works. Prechlorination or violent air blowing (10 min.) had greatly improved coagulation where ferric salts were involved. A rapid flash mix followed by slow flocculation produced the most satisfactory results. At Liberty, N. Y., the effectiveness of "Black-Alum" (alum containing carbon) was superior to iron salts whose floc was more rapidly produced and easily broken up thereafter at points of drop or high velocity. In plant design this condition had to be faced and break-up points eliminated.

Mr. Griffin stated that return of sludge (recirculation) could be overdone because iron precipitate held too long in the system suffered some reduction and marked peptization, producing a brownish colloidal like iron carrying effluent. In connection with activated sludge a valuable kink to hold bulking in check seemed to be a mild chlorination of the recirculated (returned) sludge. At Lima, Ohio, Hagerstown, Md., and now reported from South Australia, had the method been fruitful and economical.

Iron salts added to sewage had, in addition to odor control or chemical precipitation, produced some economically interesting results in markedly improving sprinkling filter efficiencies and also in producing a better separation of supernatant liquor in digesters and checking foaming. The markedly higher loadings permissible with iron treated sewage applied to sprinkling filters was being utilized by Weiderman and Singleton in reducing construction costs at one of the new Atlanta plants.

L. H. ENSLOW commented on the phenomena of iron salts in their effect on sprinkling filter efficiencies, the most interesting aspect being that regardless of the absence of any precipitation ahead of the filters and no worthwhile reduction of the oxygen demand load, the presence of iron in some unexplained manner made it possible to double or treble the loadings on the Atlanta filter run in parallel with others receiving the same settled sewage without iron. It was noticeable that the effluent from the test unit contained much finely divided precipitate which required a small agglomerating dosage of coagulant ahead of the secondary tank. This seemed to indicate a decolloidizing effect due to contact of iron bearing sewage with the stone surfaces. This observation led to the thought that possibly recirculation through contact beds of stone at high rates might become an excellent method of reducing dosages (costs) in chemical precipitation procedures if used in combination with a slow motion flocculator assisted by a small secondary application of coagulant.

HARRY A. FABER, Ass't. Engr. of The Chlorine Institute, when asked to present data on chlorination of returned sludge for "bulking" control at Hagerstown, Mo., reported that the permissible dosage seemed to be very broad. Calculated on the volume of sludge returned, the effective Hagerstown dosage was on the average 4 p.p.m. whereas dosages as high as 12 to 15 p.p.m. were used at times without ill effect. Upon discontinuing the chlorination bulking conditions returned Lima, Ohio, had earlier demonstrated the efficiency of return sludge chlorination and only recently a 3 weeks experience reported from Adelaide, Australia, by Hodgson (now in America), indicated that as little as 2 p.p.m. dosage with an hour of reaeration of the returned sludge had been effective. There the sludge was rather thinnish (about 1,000 p.p.m. suspended solids) and possibly accounted for the low dosage which on a sludge of 2,000 p.p.m. solids would have been double—4 p.p.m. as at Hagerstown. The promptness of the effect attained (within 24 hours at the Adelaide plant) was particularly interesting as was the exceptionally low (2 p.p.m.) suspended solids content of the final tank effluent. Asked for an explanation, Mr. Faber replied that he hazarded no opinions or theory and was content with merely reporting observed results as they were recorded.

L. R. SETTER explained the mechanism of ferric coagulation in low vs. high pH ranges which become complex in the range below pH 5.

W. A. HARDENBERG, in reviewing experiences with ferric iron and "Black Alum" at the Liberty, N. Y., plant, said that the pH of the sewage 8.4 to 8.8 favored alum coagulation—the high pH being caused by laundry wastes.

Question Box

With Dr. Rudolfs in charge the following are in part the questions drawn from the box by him and assigned for reply:

"What methods for residual chlorine in effluents was considered the most dependable?" Mr. Faber favored the orthotolidin test except where nitrites interfered. The qualitative neutral starch-iodide test is parallel with orthotolidin would reveal.

"Do sewerage engineers look with favor on grinding of garbage and its disposal down sewers?" Morris Cohn replying, said that he hoped so. The 15 G.E. household grinders he had asked engineers to try in their homes had been most satisfactory. As to the effect on sewage treatment, the findings at Indianapolis (Ind.) (to be reported by Calvert and Tolman in the next issue of WATER WORKS AND SEWERAGE) had proved the extra loading on the plant did not upset the functioning of the bio-flocculation (one time activated sludge) process.

John R. Downes stated that the Plainfield (N. J.) plant had been forced to remove much garbage (unground) from the sewage for years. To do so a R. W. type fine screen had been installed and the screenings buried. They had been considering a grinder and return of the material to the screened sewage, but certainly the material as received gave troubles and resulted in an unsightly grease and garbage covered settling tanks, clogged filter nozzles, etc.

"What is the relative importance of knowing digester gas composition?" Finding no "takers" Dr. Rudolfs replied that a determination of carbon dioxide content and finding more than 20 per cent would show what to expect in the way of onset of acid digestion, overloading and oncoming foaming.

L. H. ENSLOW directed attention to the value of continuous recorders of carbon dioxide content of digester gas such as those at the new Durham (N. C.) plant. The record was a more dependable and quicker showing index of conditions within the tank than were laboratory tests of sludge or liquor. The record was watched for the warning signals of digester overloading, viz., a sharply falling B.t.u. value of the gas, indicative of raising CO_2 content.

"Is iron in sewage beneficial to treatment processes?" This question was put to Dr. Rudolfs for an answer. His reply was that the benefits of adding small dosages of iron salts to sewage were not sufficiently appreciated. When iron is present, troubles are less except where the iron content had been excessive. Dr. Rudolfs believed that the success of Imhoff tanks of 1 cu. ft. per capita digestion space in the Ruhr district of Germany could be attributed to the iron present. Elsewhere iron had been of benefit. Iron in sludge digesters unquestionably produced clearer separation of supernatant, denser and more readily drainable sludge, less odors and sulphide in the gas and slightly less gas.

The Quickest Way—Thrills from the Air

CALIFORNIA OR BUST!

"CALIFORNIA OR BUST!"—that was the cry of the Forty-Niners.

They didn't have concrete highways across the deserts of Arizona and California, or luxurious air-conditioned trains or over-night planes or palatial steamers through the tropics and the "big-ditch" across the Isthmus of Panama—or the WATER WORKS SPECIAL to take them out—but they got there.

The A. W. W. A. Convention and the yen to "See America First" is calling strongly in the ears of all water works men to head for Los Angeles for the Convention June 8th-12th. There is an old saying that the sweetest grapes hang the highest and many have learned how to reach them if they try hard enough.

Now, it may be unfair to those who can not spare the time or find the money, but just to make it tough on those who *think* that they can not get away or spare the price of the trip, and are growing stale sticking too close to the "grind-stone," we are presenting an outline of the routing of the Trans-Continental Water Works Special. The Convention Management Committee has chosen the most scenic route to Sunny California, and then back through the Great Northwest and the awe-inspiring Canadian Rockies, that one could select—even at double the price. What a three weeks of vacation, sight-seeing, relaxation—and, a National Convention thrown in. Already almost two hundred (see list in March issue) have sent in their names saying "Yes—I am going to the Los Angeles Convention."

All who are going may not be able to take the three weeks required and will go out on the Special (1 week tour going out) and return by the most direct route. Others may go out direct and return with the Convention crowd by way of the Canadian Rockies (1 week tour returning). There will be some who may not be able to afford the price of the tour trips in either direction, or the time required. Many, however, will find the $173.00 for rail and berth from New York City and back (much less from other points) and will travel by selected routes out and back, seeing different parts of the country in each direction.

Below is given the routing and schedule of the Water Works Special—All Aboard for California!—"Captain" John Warde (Chairman of A. W. W. A.'s Transportation Committee) will pull the cord—and they are off!

Routing of Water Works Special

May 29th—Leave New York City late afternoon.
(Pennsylvania R.R. via Pittsburgh, Columbus, Indianapolis, St. Louis, Kansas City—picking up passengers enroute to Colorado Springs.)

May 30th—Columbus, Indianapolis, Kansas City.
(No stop overs.)

May 31st—Arrive Colorado Springs, Colo., about Noon.
(Tour of Garden of the Gods, Cheyenne Canyon, Seven Falls, Dinner-Dance and night at Hotel Antlers, Colorado Springs.)

June 1st—Leave Colorado Springs for Salt Lake City.
(Route over America's Most Scenic Railroad—D. and R. G. —through Pueblo, around Pike's Peak, through the famous Royal Gorge of the Arkansas, through Leadville. A stiff climb over the Rockies at the highest crossing on any trans-continental railway. Then rapidly down to the Great Salt Lake.)

June 2nd—Salt Lake City, Utah.
(A day devoted to visiting historic and interesting points including World's Largest Copper Mines, famous Mormon Temple, Bingham Canyon, Saltaire Beach for a float on America's Inland Sea.)

June 3rd—Bryce Canyon—Zion National Park.
(A three day tour by motor busses through this awe-inspiring, grotesque and beautiful territory, created by water erosion and wind carving.)

June 6th—Las Vegas, Nev., and Boulder Dam.
(A real, not superficial, inspection of America's No. 1 Dam and its operations. Also, the Softening Plant of Boulder City, handling the difficult waters of the Colorado River.)

June 7th—Arrive at Los Angeles.
(Arriving early Sunday allows a pre-convention day of sight-seeing or recreation. Some will want to just bask in California's famed sunshine.)

June 8th-12th—THE CONVENTION.
An excellent technical program especially designed for operating men, managers, superintendents, has been set up by Linn H. Enslow, and his Committee on Publications and Program. Watch for completed program in the leading technical magazines, as soon as released.
Members and guests of A. W. W. A. will breakfast with the famous Breakfast Club of Los Angeles, will see infamous Hollywood, will golf and sight-see on Wednesday afternoon in Southern California Sunshine. Plenty of other entertainment provided by Bill Orchard and his California Committee on Entertainment.

June 12th—ALL DAY TOUR.
To points of interest in and around Los Angeles and visit to most interesting points on the Los Angeles Water Supply System will be under the direction of Los Angeles' W. W. (Bill) Hurlbut, president-elect of A. W. W. A.

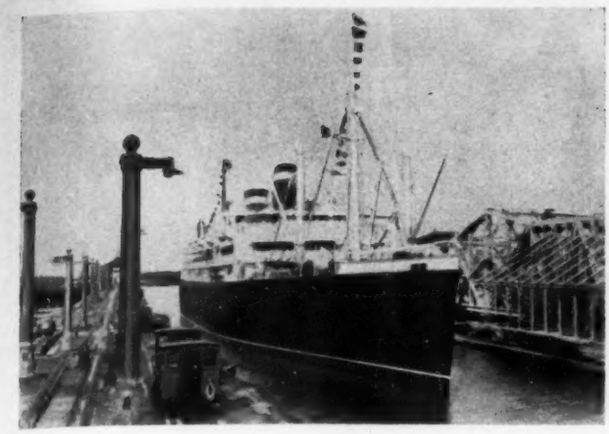
RETURN TRIP*

June 12th—Leave Los Angeles for Del Monte via picturesque Coast Route.

June 13th—Monterey Peninsular Sight-Seeing trip. The night in San Francisco.

June 14th—San Francisco, The Golden Gate, Chinatown.
(A day of sight-seeing in the invigorating climate of this famed metropolis of the far-west.)

June 15th—Arrive Portland, Ore.
(Motor trip up the renowned Columbia River Highway with



The Leisurely Globe Trotting Way. Through the Blue Caribbean, the Tropics and the Panama Canal.

its magnificent scenery and numerous famed water-falls dropping to the roadside, seen from open top cars.)

June 16th—Arrive Seattle, Wash. (No stop over.)
(From Seattle to Vancouver via fast steamer—stopping at beautiful Victoria, B. C., for a brief visit.)

June 16th—Arrive Vancouver, B. C. (No stop over.)
(Leave by Canadian Pacific Railway through the awe-inspiring Canadian Rockies to the gem-like Emerald Lake and mirror-like Lake Louise.)

June 17th—Leave Lake Louise for Bannf, Alta.
(The night at the palatial Bannf Springs Hotel. Sight-seeing and golf the following day.)

June 18th—Leave Bannf for St. Paul, Chicago and the East.
(Arriving St. Paul-Minneapolis A. M. 20th; Chicago, P. M. 20th; New York City, Sunday afternoon, June 21st.)

TRIP RATES

From New York City, N. Y.
(Including all expenses en-route in both directions)

(a) With lower berth.....$350.00 per person
(b) With upper berth..... 335.00 per person
(c) Two in lower berth..... 315.00 per person
(d) Drawing room (3 people)..... 365.00 per person

*Members and guests who are unable to spare the necessary time to take the highly scenic specially arranged return trip through the Canadian Rockies may elect a direct return trip or, if preferable, one which takes them through other points of interest—including the Panama Canal.

The cost of direct trip to West Coast and return is only $173.00 from New York City, including lower berth.

Arrangements should be made through John F. Warde, 50 Church Street, New York City—Chairman of Transportation Committee, who is handling arrangements and routings for the Association. He will tell you how to get out and back by any desired combination of routings, and the cost.

The Technical Program

SUNDAY, JUNE 7

EVENING

7:00 Registration.
8:00 Conference Room No. 10. Board of Directors.

MONDAY, JUNE 8

FORENOON

8:30 Registration.
9:30 Music Room. Committee Reports.
11:00 Music Room. Main Session.

AFTERNOON

2:00 Music Room. Main Session. Plant Management and Operation Division and Superintendents' Round Table Discussion.
2:00 Conference Room No. 1. Water Purification Division.
5:00 Conference Room No. 6. California Section, A.W.W.A., Directors' Annual Meeting.

TUESDAY, JUNE 9

FORENOON

9:30 Music Room. Main Session.
9:30 Conference Room No. 1. Water Purification Division.

AFTERNOON

2:00 Music Room. Main Session.
2:00 Conference Room No. 1. Water Purification Division.

WEDNESDAY, JUNE 10

FORENOON

10:00 Music Room. Main Session.
10:00 Conference Room No. 8. Finance and Accounting Division.
10:00 Conference Room No. 6. Sub-Committee 5-I-D, Standards of Water Quality.
10:45 Conference Room No. 9. Sub-Committee on Specifications and Tests for Activated Carbons.
11:30 Conference Room No. 5. Committee on Water Works Short Schools and Licensing of Water Works Employees.

THURSDAY, JUNE 11

FORENOON

9:30 Music Room. Joint Session of General Membership and Water Purification Division.
9:30 Conference Room No. 8. Finance and Accounting Division.

AFTERNOON

2:00 Music Room. Plant Management and Operation Division.
5:00 Conference Room No. 10. Board of Directors.

ENTERTAINMENT

MONDAY, JUNE 8

6:30 Dinner. "Service des Eaux."
9:00 Reception and Dance. Informal. Biltmore Bowl.

TUESDAY, JUNE 9

7:15 All-Division Dinner. Informal. Biltmore Bowl.

WEDNESDAY, JUNE 10

8:00 a. m. Breakfast at the Los Angeles Breakfast Club. Golf Tournament. Excursion.
9:00 p. m. Smoker. Ladies invited. Biltmore Bowl.

THURSDAY, JUNE 11

12:30 Luncheon. Finance and Accounting Division.
7:30 Dinner-Dance. Informal. Biltmore Bowl.

Dates of Ladies Luncheon Bridge and Sight-Seeing Trip will be announced later.

SUNDAY EVENING

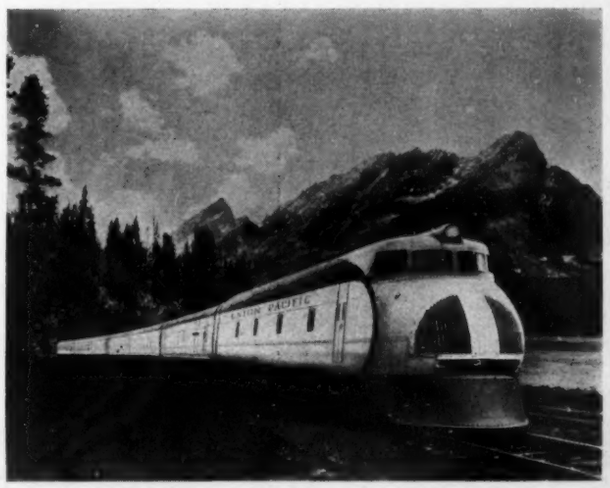
7:00 Registration.
8:00 Conference Room No. 10. Board of Directors.
Members having business to bring before the Board should present it in writing to the Secretary before this meeting.

MONDAY FORENOON

8:30 Registration.

MAIN SESSION, MUSIC ROOM

9:30 Committee 1, Basic Data.
Elson T. Killam (Chairman), New York, N. Y.
Committee 3, Surface Water Collection.
Thorndike Saville (Chairman), New York, N. Y.
Committee 5, Quality and Treatment of Water.
Paul Hansen (Chairman), Chicago, Ill.
Sub-Committee 5-I-D, Standards of Quality of Water and Joint Editorial Committee on Standard Methods for the Examination of Water and Sewage.
Harry E. Jordan (Chairman), Indianapolis, Ind.
Sub-Committee 7-A, Steel Plate Pipe for Water Supply.
Leonard P. Wood (Chairman), New York, N. Y.
Sub-Committee 7-E, Valves, Sluice Gates and Fire Hydrants.
William R. Conard (Chairman), Burlington, N. J.
Sub-Committee 7-H, Steel Standpipes and Elevated Tanks.



The Most Scenic Way—in Modern Equipment.

Louis R. Howson (Chairman), Chicago, Ill.
Sub-Committee 7-T, Transite Pipe.
Clarence R. Knowles (Chairman), Chicago, Ill.
Committee on Electrolysis and Electrical Interference. (See also P.)
Charles F. Meyerherm (Secretary), New York, N. Y.
Committee on Water Works Short Schools and Licensing Water Works Employees. (See also P)
Lewis V. Carpenter (Chairman), New York, N. Y.
Committee on Hazards to Plant and Personnel from Use of Chlorine and Other Chemicals.
Marsden C. Smith (Chairman), Richmond, Va.
Joint Committee on Water Works Terms.
Thorndike Saville, New York, N. Y.
Sectional Committee on Specifications for Cast Iron Pipe. (A. S. A. Committee A-21.)
Thomas H. Wiggin (Chairman), New York, N. Y.
National Water Policy Committee. (See also P.)
Abel Wolman (Chairman), Baltimore, Md.

11:00 Opening of Convention.
Frank A. Barbour, President.
Announcement of Officers elected for the year 1936-1937.
Reports of Secretary, Treasurer and Board of Directors.
Action on Budget.
New Business.
What's Ahead for A. W. W. A.
The President, Frank A. Barbour.

MONDAY AFTERNOON

MAIN SESSION, MUSIC ROOM

Plant Management and Operation Division.
William W. Hurlbut (Chairman), Los Angeles, Calif.
Superintendents' Round Table Discussion.

2:00 Experience with Automatic Control Equipment at Pumping Stations.
H. A. Harris, Jr., San Francisco, Calif.

2:40 Modern Air Conditioning—What It Means to the Water Utility.
L. L. Lewis, Newark, N. J.
Discussion: J. S. Strohmeyer, Baltimore, Md.; M. K. Fahnestock, Urbana, Ill.

3:30 Operating Experiences in Water Supply at Waco, Tex.
George J. Rohan, Waco, Tex.

4:00 Modern Trends in Fabrication and Design of Water Towers and Elevated Tanks.
George T. Horton, Chicago, Ill.

4:30 Some Interesting Facts Uncovered in a Survey of Properties Not Served with City Water.
H. V. Pedersen, Marshalltown, Ia.

MONDAY AFTERNOON (continued)

WATER PURIFICATION DIVISION, CONFERENCE ROOM No. 1
Albert E. Berry (Chairman), Toronto, Canada.

2:00 Review of Report of Sub-Committee on Specifications and Tests for Activated Carbons.
Mathew M. Braidoch (Chairman), Senior Chemist, Baldwin Filtration Plant, Cleveland, O.

2:45 Methods of Testing and Significance of Boron in Water Supplies.
Ray L. Derby, Los Angeles, Calif.

3:30 Methods of Testing and Significance of Fluorine and Fluorides in Water Supplies.
Joseph M. Sanchis, Los Angeles, Calif.

4:15 Plankton and Insect Larvae Control in California Waters.
Gerald E. Arnold, Millbrae, Calif.

MONDAY EVENING

5:00 Conference Room No. 6. California Section, A.W.W.A., Directors' Annual Meeting.
6:30 Dinner. "Service des Eaux."
9:00 Reception and Dance. Informal. Biltmore Bowl.
"Get-Together" for those who do not dance.
Bridge and Rendezvous.

TUESDAY FORENOON

MAIN SESSION, MUSIC ROOM

California Day

9:30 Romance in the Development of Los Angeles' Water Supply.
H. A. Van Norman, Los Angeles, Calif.

10:15 Benefits Accruing from the Hetch-Hetchy Project, San Francisco Water Supply.
N. A. Eckhart, San Francisco, Calif.
Discussion: George W. Pracy, Supt., Water Dept., San Francisco, Calif.; Frank E. DeMartini, San Francisco, Calif.

11:00 Progress on the Colorado River Aqueduct of the Metropolitan Water District of Southern California.
Franklin Thomas, Pasadena, Calif.

11:45 Features of Equipment and Design of Pumping Stations on the Colorado River Aqueduct.
Max Spillman, Los Angeles, Calif.

12:15 Discussion: Robert L. Daugherty, Pasadena, Calif.

TUESDAY FORENOON (continued)

WATER PURIFICATION DIVISION, CONFERENCE ROOM No. 1

9:30 Iron Removal at Lincoln Nebraska.
N. T. Veatch, Jr., Kansas City, Mo., and D. H. Erickson, Lincoln, Nebr.

10:15 Iron and Manganese Removal by Zeolites and Manganese Zeolite Processes.
Eskel Nordell, New York, N. Y.

11:00 The Use of Beds of Manganese Ore in Iron and Manganese Removal.
William G. Kirchoffer, Madison, Wis.
Discussion: Carl Zapffe, Brainard, Minn.; M. J. Shoemaker, Madison, Wis.; A. S. Behrman, Chicago, Ill.

11:45 Analytical Control of Anti-Corrosion Water Treatment.
Wilfred F. Langelier, Berkeley, Calif.

TUESDAY AFTERNOON

MAIN SESSION, MUSIC ROOM

2:00 The Dual Usage of Water for Domestic and Irrigation Purposes.
J. B. Lippincott, Los Angeles, Calif.

2:45 Experience in Ground Water Depletion by Unregulated Pumping.
William W. Brush, New York, N. Y.

3:30 The Value of and Methods Used in Artificial Storing of Ground Water by Spreading.
D. A. Lane, Los Angeles, Calif.

4:25 Developments in the Program of Conservation of Water Resources as a Federal Measure: On Stream and Ground Water Control and on Hydrologic Data.
Abel Wolman, Baltimore, Md.

TUESDAY AFTERNOON (continued)

WATER PURIFICATION DIVISION, CONFERENCE ROOM No. 1
Symposium on Filtration

2:00 Mixing.
Carl M. Hoskinson, Sacramento, Calif.

2:35 Coagulation.
Kenneth W. Brown, Stockton, Calif.

3:10 Filter Design as Related to Operation.
Harry N. Jenks, Berkeley, Calif.

3:45 Filtration Without Preliminary Coagulation.
Joseph D. DeCosta, Oakland, Calif.

4:25 The Maintenance of Filtration Plant Equipment. John Perhab, Beverly Hills, Calif.

TUESDAY EVENING

7:15 All-Division Dinner. Informal. Biltmore Bowl.

WEDNESDAY FORENOON

8:00 The Los Angeles Breakfast Club. Breakfast and a Laugh Over the Coffee Cup.

MAIN SESSION, MUSIC ROOM
The Cost of Tuberculation—A Symposium

10:00 Digest of the Report of the N.E.W.W.A. Committee on Friction Coefficients of Pipe Lines.
Elson T. Killam, New York, N. Y.

10:35 Observations of Conditions of Mains in Typical American Cities—The Effects of Water Quality and Protective Linings.
Edgar K. Wilson, New York, N. Y.

11:10 Economic Significance of Improved Pipe Linings.
Frank A. Barbour, Boston, Mass.
Discussion of two preceding papers by Thomas H. Wiggin, New York, N. Y.

11:45 Experience in the Rehabilitation of a Large Main.
Clinton Inglee, New York, N. Y., and W. G. Bank, Newark, N. J.
Discussion: Fred B. Nelson, New York, N. Y.

12:20 Protective Treatment of Steel Lines as Developed in the Los Angeles Bureau of Water Works and Supply.
Harry Hayes, Los Angeles, Calif.
Discussion: L. E. Goit, Los Angeles, Calif.

WEDNESDAY FORENOON (continued)

FINANCE AND ACCOUNTING DIVISION, CONFERENCE ROOM No. 8
Louis D. Blum (Chairman), New York, N. Y.

10:00 The Attorney System as a Modern Method of Collecting Water Accounts.
Samuel W. Zerman, Weehawken, N. J.

10:45 A Study of the Trend of Customer Accounting Practice
Hal F. Smith, Detroit, Mich.

11:30 Reorganization Experience in the Denver (Colo.) Water System.
E. G. Plowman, Denver, Colo.

12:15 Present Trends Towards Simplification of Rate Case Procedure.
Jacob Schwartz, Newark, N. J.

WEDNESDAY FORENOON (continued)
Committee Meetings

10:00 Conference Room No. 6. Sub-Committee 5-I-D, Standards of Water Quality.
Harry E. Jordan, Indianapolis, Ind.

10:45 Conference Room No. 9. Sub-Committee on Specifications and Tests for Activated Carbons of the Water Purification Division Committee on Specifications and Tests for Water Purification Chemicals.
Mathew M. Braidech, Cleveland, O.

11:30 Conference Room No. 5. Committee on Water Works Short Schools and Licensing of Water Works Employees.
An open forum meeting. Operators especially invited.
Lewis V. Carpenter (Chairman), New York, N. Y.

WEDNESDAY AFTERNOON
No Technical Sessions
Afternoon left open for Golf Tournament; Excursions to Points of Interest; Inspection Trips, etc.
Enjoy California's Sunshine!

WEDNESDAY EVENING

9:00 Smoker—Ladies Invited. Biltmore Bowl.

THURSDAY FORENOON
Joint Session of General Membership and Water Purification Division, Music Room.

9:30 Iron Removal Without Aeration—The Precipitation of Ferrous Carbonate in a Closed System.
Frank E. Hale, New York, N. Y.
Discussion: Robert Spurr Weston, Boston, Mass.

10:00 Developments in Raw Water Preparation and the Use of Chlorinated Copperas at Richmond, Va.
Marsden C. Smith, Richmond, Va.
Discussion: L. L. Hedgepeth, Philadelphia, Pa.; Ralph A. Stevenson, Los Angeles, Calif.

10:45 Developments in Water Supply Practice.
(a) Dams, Pipe Lines, Pumping.
Samuel B. Morris, Palo Alto, Calif.

11:00 (b) Water Treatment.
Linn H. Enslow, New York, N. Y.

11:15 (c) Distribution and Service.
William W. Brush, New York, N. Y.

11:30 Seen and Heard in the Field. (Kinks, Gadgets, Ideas.)
Fred E. Stuart, New York, N. Y.
Discussion: Leon B. Reynolds, Palo Alto, Calif.; George D. Norcom, New York, N. Y.

THURSDAY FORENOON (continued)
FINANCE AND ACCOUNTING DIVISION, CONFERENCE ROOM No. 8

9:30 Application of Tabulating Equipment in Accounting Procedure.
Frank Twohy, Los Angeles, Calif.

10:15 Overcoming Public Opposition to Water Works.
H. L. Meites, Chicago, Ill.

11:00 Public Relations.
James E. McCaffrey, Los Angeles, Calif.

11:15 Unemployment Compensation—Some Pertinent Considerations.
Hon. Samuel Leask, Jr., Santa Cruz, Calif.

12:30 Luncheon and Round Table Discussion relative to "Uniform Classification of Accounts."

THURSDAY AFTERNOON
MAIN SESSION, MUSIC ROOM
PLANT MANAGEMENT AND OPERATION DIVISION

2:00 Statement of Committee on Electrolysis and Electrical Interference, on Present Status of the Grounding Problem and on Program of the new joint American Research Committee on Grounding.
Charles F. Meyerherm, New York, N. Y.
Discussion: Robert R. Ashline, Los Angeles, Calif.

2:30 Residual Chlorinators as Used on the Los Angeles System.
Ray F. Goudey, Los Angeles, Calif.

3:00 Record Control of the Construction, Maintenance and Operation of a Distribution System.
E. W. Breitkreutz, Los Angeles, Calif.

3:30 The Memphis Meter and Leak Tester.
C. M. McCord, Memphis, Tenn.

3:45 Superintendents' Round Table Discussion.
What Per Cent of Income of Water Utility Is Justified for Use in Plant and Property Beautification?
Discussion led by George W. Pracy, San Francisco, Calif.
Jointing Materials for Water Mains—Experience With Cement.
Discussion led by F. M. Murphy, El Paso, Tex.
Disinfection of New and Repaired Mains.
Discussion led by A. M. Brenneke, Denison, Tex.

THURSDAY EVENING

5:00 Conference Room No. 10. Board of Directors.

7:30 Dinner-Dance. Informal. Biltmore Bowl.
Presentation of John M. Diven Memorial Medal.
Presentation of John M. Goodell Prize.
Introduction of Newly Elected Honorary Members.

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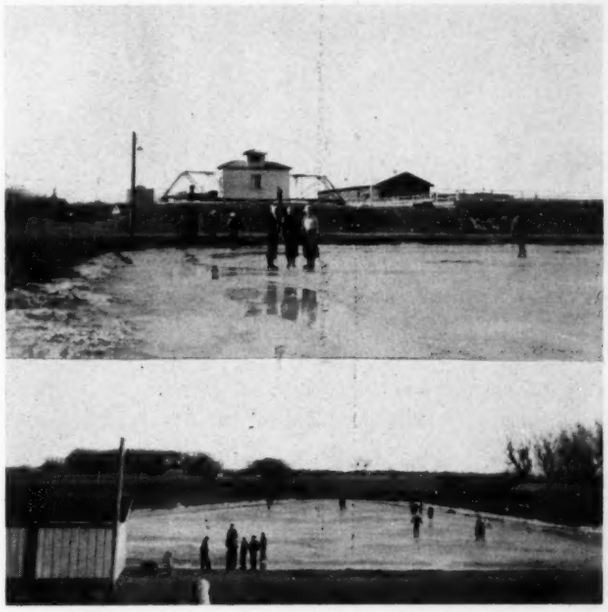
Grand Island Still Skates on "Activated Ice"

Some time ago there appeared in WATER WORKS AND SEWERAGE a brief story relating the use of effluent from the Grand Island (Neb.) activated sludge plant to form a skating pond. The above snapshot was made early this Spring and we understand that the pond is to be



Skating Pond at Grand Island Sewage Plant

enlarged to take care of winter "overloading." We wonder how the little "Bi-Colis" feel after being froze' up to have their spines skated up and down. But—steady—maybe the little "Bi-Colis" have first been humanely put to death with chlorine. Possibly Grand Islanders skate on super-chlorinated, de-activated ice. Be that as it may, Grand Islanders think it's a swell idea.

▼

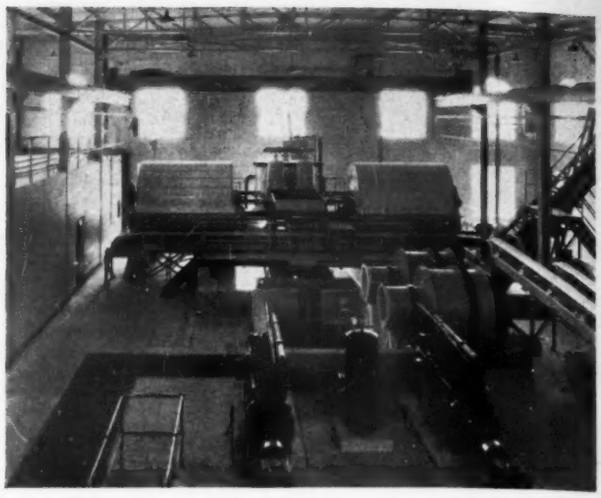
New Role of the Water Diviner

From the *London Times* appears the following interesting and admirably succinct report concerning the new possibilities of dowsers and water witches.

After four days' police search for Harry Buckles, 51, a carpenter of Dedham Colchester, who had been missing from home, a water diviner yesterday offered his services. Holding in his hands a piece of the missing man's clothing and a piece of copper wire, he indicated a spot in the River Stour, where the police, after dragging operations, recovered Buckles' body.

In a moving cartoon of Silent Sam, reproduced in recent months in these pages, Sam used a water-witch in locating what appeared to be a water vein for putting down a well on his lot. Digging had not proceeded far when up-turned a smile to be followed by a jug of *spiritus-fermenti* which the silent one had buried during prohibition times but had seemingly lost his map of location of the treasure.

Detective schools take note; and, consider offering a graduate course in dowsing. The degree might be "D.D.D."—Doctor of Detective Dowsing.



Sludge Filters and Lime Slakers, Perth Amboy Plant

OPERATING EXPERIENCES AT PERTH AMBOY'S CHEMICAL TREATMENT PLANT*

By S. I. ZACK,

Sanitary Engineer,
Filtration Equipment Corporation,
New York, N. Y.

S. I. Zack

OPERATION of the Perth Amboy (N. J.) Chemical-Mechanical Treatment Plant was started in June, 1935. Ferric chloride and lime were added to the sewage as precipitants through September. Since October 1st the plant has been operated very successfully by filtering upward through automatic magnetite filters, without addition of chemicals for precipitation prior to filtration. The plain settled sludge produced from non-chemically treated sewage and drawn from the clarifiers has been satisfactorily dewatered on vacuum filters after conditioning with lime and ferric chloride.

Description of Plant and Its Operation

The plant has a 10 m.g.d. average and 20 m.g.d. peak load capacity. It consists of the following: a building 101.5 feet long by 75 feet wide, which houses the bar screens, pumps, chemical feeding and sludge handling equipment, laboratory, offices and locker rooms. 2 air flocculating channels each 90 ft. long by 8.5 ft. deep and 8.5 ft. wide for adding and mixing chemicals with sewage and for floc formation prior to sedimentation; two clarifiers 80 ft. diameter by 10 ft. side water depth, each equipped with an automatically cleaned upflow Laughlin magnetite filter similar to those at Dearborn; a chlorination building and contact chamber. The clarifier has a central sludge sump 8 ft. in diameter and of 6 ft. depth.

Sewage flows through two Laughlin mechanically cleaned bar screens into a wet well from where it is elevated by diesel-driven pumps to the inlet of the flocculating channel. Liquid ferric chloride is added to the pump suction by a specially designed feeder, which controls the dose according to the volume of sewage flowing through the venturi meter.

Lime is stored in bins and discharged onto a belt through lime feeders. The speed of the belt is controlled by the venturi meter. The belt discharges into pebble mills where the lime is slaked before being added to the inlet of the flocculating channel. The same apparatus has been found suitable for feeding Prestolite lime which has recently replaced the unslaked quick lime. The pebble mills are designed for preparing paper pulp if that should be found desirable.

After flocculating, sewage enters the clarifier. Sludge settles and is withdrawn from the bottom, and the effluent filters upward through the magnetite filters. In non-chemical treatment the flow is the same, except that no chemicals are added to the sewage which enters the clarifiers.

Sludge is pumped from the clarifiers to a sludge conditioning tank by means of plunger type pumps. Lime and ferric chloride are added to the sludge and flows by gravity to the two 8-ft. diameter by 10 ft. face Conkey vacuum filters. When no chemicals are added to the raw sewage, the sludge conditioning procedure is the same except that the amount of conditioner required is greater, as a rule.

Sludge cake is discharged on a belt and conveyed by a flight conveyor on a 60-degree slope to a sludge loading hopper. Sludge is trucked to a ravine about 2 miles from the plant where it is disposed by dumping. Recently sludge has been used as fertilizer in the city parks.

Ferric chloride is stored in a rubber lined tank (of ton-car capacity) located outside of the building. It is filled through several hundred feet of rubber hose from a nearby railroad siding.

*An article based on a paper presented before the New York State Sewage Association on Jan. 15, 1936, and brought up to date by the authors for publication in WATER WORKS AND SEWERAGE.—*Ed.*

TABLE I

Operating and Analytical Results Two Months Using Chemicals
(Summer Conditions)

Date 1935	Flow Mgd.	Det. Per Hr.	Filter Rate Gal. Sq. Ft. Per Min.	Chemicals Used Lb. Per M. G. Lime	Chemicals Used Lb. Per M. G. $FeCl_3$	Suspended Solids Inf.	Suspended Solids Eff.	Suspended Solids Pct. Rem.	5 Day B. O. D. Inf.	5 Day B. O. D. Eff.	5 Day B. O. D. Pct. Rem.
July	2.6	3.7	0.70	643	291	215	21	90	242	86	65
August	2.9	3.2	0.79	675	214	264	35	87	271	116	55
Average	2.8	3.5	0.75	659	252	240	28	89	257	100	60

TABLE II

Operating and Analytical Results Non Chemical Treatment
(Fall and Winter Conditions)

Date 1935-1936	Flow Mgd.	Det. Per Hrs.	Filter Rate Gal./ Sq. Ft. Per Min.	Suspended Solids Inf.	Suspended Solids Eff.	Suspended Solids Pct. Rem.	5-Day B.O.D. Inf.	5-Day B.O.D. Eff.	5-Day B.O.D. Pct. Rem.
October	2.79	3.4	0.76	200	59	71	264	186	30
November	3.27	2.8	0.89	185	58	69	222	153	31
December	3.33	2.6	0.93	225	68	70	262	181	31
January	4.30	2.0	1.20	197	63	68	185	128	31
February	4.53	1.9	1.27	202	55	73	168	121	28
Average	3.64	2.4	1.00	202	60	70	220	154	30

Character of Sewage

The sewage tributary to the plant comes from a combined system receiving storm flows and miscellaneous wastes from about 40 industrial plants. The principal industries consist of copper lead smelters and refineries, pickling, asphalt, chromium plating, copper cable, terra cotta and packing house plants. The sewage, therefore, varies over a wide range in volume, strength and character. During a 24-hour period pH values of 2.0 to 9 have been observed.

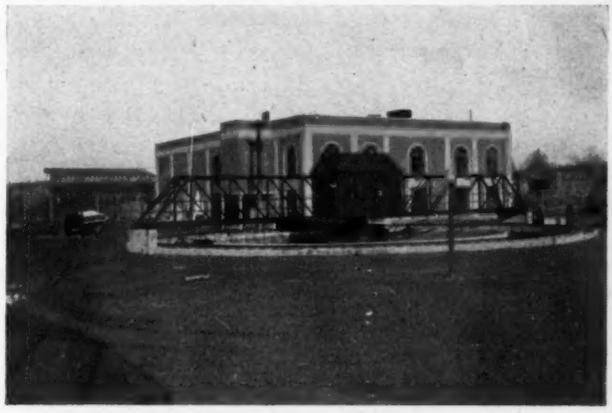
Operating and Analytical Results

The flows treated at the plant have averaged about 3 m.g.d. which is considerably below design capacity. This entire flow has been handled in one clarifier. It was originally planned to use full chemical treatment during the summer and partial chemical treatment the remainder of the year. But, tests conducted during September have shown the magnetite filter to be operative without chemical treatment. It was also found that sufficient suspended solids were removed to make it possible to dispense with chemical treatment the greater portion of the year. Operation has, therefore, been essentially without chemicals since October 1st.

Operation and analytical results are divided into two periods, representing chemical and non-chemical treatment as follows:

Table I shows the data for July and August representing the period of chemical treatment and summer operation. Table II reveals results of 6 months operations during the period of non-chemical treatment.

The maximum daily average flow treated in one clarifier has been 6.0 M.G.D. with chemical treatment and 6.6 M.G.D. without chemicals. For part of a day maximum rates of flow of 13 M.G.D. have occurred both with and without chemical treatment. This represents a detention period of 0.72 hours and a filter rate of 3.5 gal. per sq. ft. per min. Under these maximum conditions the flows have passed through the filter without appreciable increase in loss of head.



The Perth Amboy Plant No. 2 Clarifier and Filter (to Right Is Out of Range)

Table III shows results through the single clarifier for several days during the chemical treatment period when daily flows averaged in the neighborhood of 5 M.G.D. Table IV shows similar days for the non-chemical treatment period. Both of these tables reveal critical results and reveal maximum loading performances which are highly significant in all methods of sewage treatment.

Difficulties and Lessons Learned

Lack of familiarity in knowing how to adjust the chemical feed for the sudden changes in flow and strength of sewage, erratic dosing and permitting sludge to accumulate in the clarifier for periods of 4 to 8 days undoubtedly had a detrimental effect on the quality of effluent. Under normal operating conditions about 2 to 3 feet of 10 to 12 per cent solid content sludge is present in the clarifier. During a period when sludge

TABLE III

Operating and Analytical Results Days of High Flows—Chemical Treatment

Date 1935	Flow Mgd.	Det. Per Hrs.	Filter Rate Gallons Sq. Ft. /Min.	Chemicals Used Lb. Per M.G. Lime	Chemicals Used Lb. Per M.G. $FeCl_3$	Suspended Solids Inf.	Suspended Solids Eff.	Suspended Solids Pct. Rem.
July 9	5.22	1.8	1.41	135	172	227	15	94
August 2	5.33	1.8	1.44	465	191	510	17	97
September 3	4.89	2.0	1.32	349	175	490	37	92
4	5.40	1.8	1.46	315	127	158	12	92
5	6.00	1.6	1.62	267	136	188	30	84

TABLE IV

Operating and Analytical Results Days of High Flows—Non-Chemical Treatment

Date 1935-1936	Flow Mgd.	Det. Per Hrs.	Filter Rate Gal./Sq. Ft./Min.	Suspended Solids Inf.	Eff.	Pct. Rem.
1935						
Oct. 30....	6.61	1.4	1.79	196	68	65
31....	5.01	1.9	1.35	58	38	35
Nov. 7....	4.71	2.0	1.27	172	63	63
17....	5.66	1.7	1.53	69	41	36
Dec. 15...	4.69	2.0	1.27	322	101	69
1936						
Jan. 2.....	6.51	1.4	1.76	435	116	73
9.....	5.61	1.6	1.52	297	58	81
Feb. 17....	6.61	1.4	1.80	263	56	79
18....	5.10	1.8	1.38	157	50	68
24....	5.43	1.7	1.48	220	80	64
25....	6.02	1.5	1.64	267	62	80
26....	5.69	1.6	1.54	177	69	61
27....	5.25	1.8	1.43	228	75	67
28....	4.95	1.9	1.35	263	46	83

in the clarifier was kept down to a minimum, about 45 per cent overall reduction of B.O.D. was obtained. The low B.O.D. reductions in July and August with chemical treatment *may* be explained by the fact that as much as 4 feet of sludge was present in the clarifier.

Removals by Magnetic Filter

Tests started at Perth Amboy by Mr. K. L. Mick, Chemist of the Minneapolis-St. Paul Sanitary District and continued for a period thereafter by the Perth Amboy plant chemist, explored the part played (performance) by the magnetite filter itself. A sample line was installed through the side of the tank below the filter and 24 hourly samples were taken each day for comparison with similar samples of raw sewage and filtered effluent.

Table V shows the removals during the chemical treatment period compared with those during the non-chemical treatment period.

Interesting Facts

In non-chemical treatment 0.74 p.p.m. B.O.D. was removed for 1 p.p.m. suspended solids removed by the magnetite filter whereas in chemical treatment only 0.33 p.p.m. B.O.D. was removed per p.p.m. of suspended solids.

The maximum removals by the filter occurred when the maximum solids reached the filter. With chemical treatment 150 p.p.m. suspended solids was removed by the filter on a day when the sample taken below the filter averaged 170 p.p.m. In non-chemical treatment 178 p.p.m. was removed by the filter when the sample below averaged 256 p.p.m. for the 24 hours. These are included to show typical recorded removals by the filter when concentrations of solids are above the average conditions. Also to show the almost complete removal of suspended solids when agglomerated as floc through efficient coagulation.

TABLE V

Removals by Magnetite Filter—Parts Per Million

	Chemical Treatment [Av. Flow 3.4 M.G.D.] Average of 15 days		Non-Chemical Treatment [Av. Flow = 3.0 M.G.D.] Average of 28 days	
	Susp. Solids	B.O.D.	Susp. Solids	B.O.D.
Raw Sewage	291	290	225	279
Under Filter [Settling effect alone]	95	128	120	204
Filtered Effluent [Settling & filter]	26	108	69	167
Removal by Filter [otherwise in effluent]	68	20	50	37

Lime = 550 lb./mg.
$FeCl_3$ = 238 lb./mg.

Chlorination

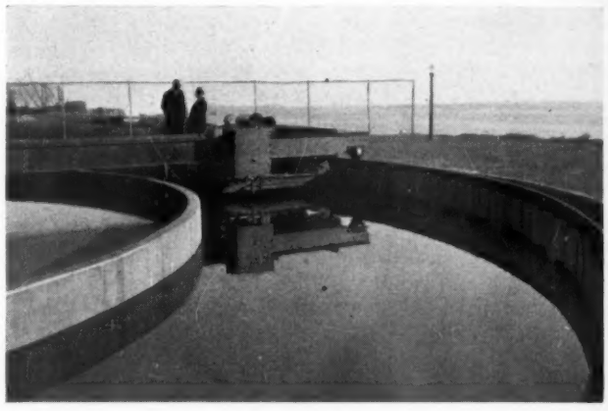
During July and August about 50 pounds of chlorine per million gallons was used. This maintained 0.05 to 0.10 residual chlorine in the chemical treated effluent. Only 20 lbs. of chlorine per m.g. was required in September, after which chlorination was discontinued for the winter.

Sludge Dewatering

All of the sludge has been handled on one of the 8x10 ft. vacuum filters, operating about 6 hours a day for about 20 days a month. The filters are idle Saturdays and Sundays.

Sludge is normally conditioned with lime and ferric chloride before dewatering. Table VI contains dewatering data by months from June to December (inclusive) covering both the chemical and non-chemical treatment periods.

During 8 continuous days in August very good results were obtained without the use of ferric chloride for conditioning. This was accomplished with about 10 pc. CaO based on dry solids. There was no increase



Magnetic Filter and Automatic Cleaning Mechanism, Perth Amboy, N. J.

in the moisture of cake or decrease in yield of dry solids from the vacuum filter. From one-half to over a million pounds of cake per month has been trucked and dumped, without apparent nuisance, into a ravine about two miles from the plant. During most of February the sludge was trucked to a city park for disposal as fertilizer.

Costs

The cost of the Perth Amboy plant including the Diesel driven pumping equipment was about $375,000. The chemical feeding vacuum filter, chlorine and magnetite filter equipment amounted to about $145,000.

The price paid for chemicals by the City of Perth Amboy was $2.55 a hundred pounds for absolute ferric chloride ($FeCl_3$) and $12.00 per ton for quicklime on 100 p.c. CaO basis. Prestolite was purchased for $6.00 per ton CaO basis.

Power used for sewage treatment, sludge dewatering and lighting, but exclusive of pumping, amounted to 135 K.W.H. per m.g. during the chemical treatment period. This was reduced to 109 K.W.H. per m.g. when the plant was operated without chemicals. If the plant were operating at design capacity to 10 M.G.D. average flow, instead of the present average of about 3.5 M.G.D., the power consumption on a million gallon basis would naturally be greatly reduced.

TABLE VI
SLUDGE DEWATERING

Date, 1935-1936	Sludge to Filters: Pct. Solids	Sludge to Filters: Pct. Vol.	Dewatered Sludge Cake Data: Pct. Moisture	Dewatered Sludge Cake Data: Pct. Vol.	Dewatered Sludge Cake Data: Pounds Wet	Dewatered Sludge Cake Data: Pounds Dry Solids	Chemicals Used Per Cent of Dry Solids: CaO	Chemicals Used Per Cent of Dry Solids: $FeCl_3$	Dry Solids Pounds Per Sq. Ft. Filter Area Per Hour
Chemical Treatment Period									
July	12.9	46	68.0	41	779,000	252,000	9.6	2.1	6.1
August	12.2	48	67.5	41	1,181,000	384,000	10.0	0.7	8.4
September*	11.0	50	68.9	40	756,700	235,450	11.3	2.1	7.9
Non-Chemical Treatment Period									
October	11.2	57	66.5	42	755,000	253,000	12.1	3.1	8.3
November **	11.7	56	67.0	50	498,000	161,000	7.0	3.1	5.7
December	10.0	44	64.9	49	471,000	165,000	9.5	2.8	8.2
January	12.3	..	64.0	..	441,000	158,500	7.8	1.7	8.2
February	12.4	..	64.6	..	420,100	148,500	8.6	1.7	7.6

*Part of month no chemicals used for coagulating sewage.
**November 12th to 30th—200 lbs. per m.g. of lime added to sewage to determine effect on sludge dewatering economy.

Separate current measurements, taken of the motor generator set on the magnetite filter, showed a power consumption of 2.38 K.w. This included the electrical current for operating one filter bed cleaner (12 feet wide around the 80 ft. tank), and included the motor drive for the sludge scrapers. This power includes the drives, solenoid and wash water pump. At the present time the cleaner operates about one-third of the time. At design capacity of the filter, the cleaner would be required to run more often. The power for continuous operation of the magnetite filter cleaner at rates of 2.00 gal. per sq. ft. per min. through the filter amounts to 8 K.W.H. per m.g. based on actual tests.

Conclusions

The Perth Amboy plant has adequately handled a sewage which might be termed difficult to treat because of its industrial origin and extremely variable character. Effluents from the mechanically cleaned magnetite filters have been uniform in the amount of suspended solids contained and the absence of suspended solids of settleable nature regardless of the loadings imposed.

The extent of effective removals of suspended solids and B.O.D. by the filter have been demonstrated by means of samples below and above the filter.

Two unique features are introduced in the Perth Amboy operation; namely, the filtering of settled effluent, without the aid of chemicals, through a mechanically cleaned filter, and the dewatering of plain settled sludge on vacuum filters, both covering a continuous period of 6 months to date.

Acknowledgment.—This plant was designed and its operation is being surpervised by Mr. Louis P. Booz, Consulting Engineer, for the City of Perth Amboy. Mr. Frank A. Leahy is Engineer in Charge of Operation and has supplied the operating and analytical data for this paper. During the test period necessary for acceptance of the chemical feeding and filtering equipment and for several months thereafter, Mr. J. Brendlen, Research Chemist, representing Filtration Equipment Corporation, was assigned to assist the city in operating the new plant.

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New Edition
American Sewerage Practice:—(A Review)

AMERICAN SEWERAGE PRACTICE—Vol. III, *"Disposal of Sewage,"* by Metcalf and Eddy, has recently been revised by Harrison P. Eddy and issued as the 3rd Edition. Size 6x9; pages, 892; illustrations, 227. Publishers, McGraw-Hill Book Company, New York City, N. Y.—Price, $7.00.

For the benefit of those not already familiar with Metcalf and Eddy's "Disposal of Sewage," a review should be of interest. This authoritative reference work deals with the chemistry and biology of sewage, sewage treatment processes, and equipment used in the treatment of sewages. The earlier edition has long been looked upon as the best treatise of its kind on the market. Five chapters of the new edition are devoted to the composition, characteristics, behavior and analysis of sewage. Methods of treatment are outlined; thereafter, dealt with in considerable detail. Added to the 3rd edition are 13 new chapters devoted to behavior of sewages; pollution and self purification of natural waters; developments in the revived and modernized chemical treatment methods; the separate treatment of industrial wastes; details of the activated sludge process; modern utilization of sludge gas; data on construction and operating costs; mechanical dewatering of sludges; and, cost data.

The second edition of "Disposal of Sewage," published in 1916, was sorely in need of revision and the new edition is a welcomed addition to reference libraries of engineers and chemists. Copies may be ordered from the McGraw-Hill Book Company for a 10-day free examination. Copies may also be ordered from "WATER WORKS AND SEWERAGE."

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Gas Domes for the New Washington, D. C., Sewage Plant (Metcalf and Eddy, Engineers)

To Combat the Corrosiveness of Digester Gas the 8 Gas Domes for the Washington Plant Are Being Fabricated of Toncan Iron. They Measure 4 Ft. in Diameter and 8 Ft. in Height; Total Weight, 10 Tons. Photo—Courtesy of Republic Steel Corpn.

NOVEL WATER WORKS OPERATING PRACTICES

By F. E. STUART*

New York, N. Y.

F. E. Stuart

THE operating practices outlined in this paper may not be entirely clear, but an attempt is made to show how the other fellow does things without going into much detail. If more detail is desired, the author will try to get the information for those interested.

General Operating Practices

The breaking through of liberated air or other accumulated gases, when washing filters, causes large mounds and hard spots in filters. Weir at Atlanta installed a ¾-inch tap on each manifold segment and connected them together by means of a streamlined copper pipe, vented at a point above the water level in the filters. A ¾-inch angle globe valve was placed on the end of this vent pipe in order that air might be released from the manifold through the pipe instead of passing up through the sand and gravel strata.

Roger Esty, superintendent, Danvers, Mass., connects an air compressor to a hydrant and forces the water out of the main through another hydrant on the line—this eliminates pumping when working on a break or repair.

Weir and Smith at Atlanta use an inflated inner tube to float 25 pound sacks of copper sulphate crystals—the inner circle of the tube being spider-webbed with small rope to hold the bag of copper sulphate. This is most effective in shallow water and along the shore line.

Superintendent Watkins of Oneonta, N. Y., has found "Activated Alum" a more flexible coagulant for conditioning water for filtration through pressure filters. When using activated carbon and alum separately, he had occasional trouble with carbon particles passing through the filters.

Chandler of the Greenwich, Conn. Water Co. adds lime ahead of the filters at approximately ¾ of a grain per gallon during seasons of manganese trouble to remove it at the filters. The average manganese is between 0.5 and 0.7 p.p.m. in the raw water. Thus, the lime does not affect the alum coagulation and color removal.

Meter Repair Practices — New Rochelle (N. Y.) Water Co. (Eugene F. Cranch, Manager)

Water meter castings are painted by spray gun equipment. The meter casting sets on a turntable which revolves slowly. The colors used are Bronze and Aluminum.

Air chambers have been installed on the influent side of all the meter testing machines. This eliminates water hammer caused by the quick opening and shutting valves, especially effective when testing large size meters.

The use of Monel metal baskets for dipping meter parts in Dearborn 134 solution has been much more economical than the use of cheaper baskets.

An electric drill held in place by a suitable clamp arrangement is used for cleaning meter parts. The drill is substituted for a rotary wire brush. This cleans meter parts in a hurry.

The uses of compressed air in a meter repair shop are many. This added convenience in meter shop repair work will speak for itself.

The use of a hand press similar to the press used on electric drills is a sure way of observing the fit of the disc in the chamber before the meter is put together. This eliminates the guess work connected with tight or ill-fitting discs.

An elevated container of gear lubricant is directly connected to a quick opening valve with spring attachment. This gives positive control of the amount of lubricant added to the gear train chamber because it closes so quickly—thus eliminating the mess which generally accompanies the handling of gear lubricant.

Operating Practices of the Hackensack Water Co. (Geo. R. Spalding, Supt. Filtration)

A box for depositing ideas for employees has resulted in many worthwhile suggestions—the employees being compensated according to the value of the suggestion.

A series of cast iron pipes—old and new, lined and unlined, show the effect of different waters and their treatment on different type mains. This model distribution system is flexible in operation. The results obtained have been very much worthwhile.

During certain seasons of the year for algae control and longer filter runs a continuous dosage of copper sulphate is applied to the raw water entering the plant—dosages varied to meet conditions.

Hackensack, the first to use powdered activated carbon, has used it continuously since 1930. It is interesting to note that the carbon is added continuously to the mixing chamber (5 to 8 lbs. m.g.), securing taste and odor control through stabilization of sludge and the carryover of carbon to the filters in the floc.

Ferric Sulphate Used at New Britain (A Correction)

In the January issue of WATER WORKS AND SEWERAGE on page 25 there appeared a brief news item concerning "Chemical Sewage Treatment at New Britain, Conn.," which listed the several chemicals used in the pilot plant, or to be provided for in the large plant.

Our attention has been called to the fact that ferric-sulphate was not mentioned amongst the other chemicals and we are advised that ferric-sulphate ("Ferrisul") was used in the pilot plant during a considerable part of the test period. With this we were familiar. The omission was probably the fault of the copy-writer in condensing a longer article, which was not detected in the editing.

Note: The above are excerpts from the author's paper delivered before the N. Y. Section of A. W. W. A. March 27th, 1936, at Oswego, New York.

*Activated Alum Corporation, 80 Broad Street, New York, N. Y.

INEXPENSIVE LABORATORY FLOCCER

By G. R. FRITH*
Chemical Engineer,
Atlanta, Ga.

WITH the importance of flocculation being widely recognized and its use becoming more prevalent in water and sewage treatment plants where chemical coagulation is employed, a demand has arisen for a simple floccer suitable for making a series of laboratory flocculating tests simultaneously.

The accompanying pictures illustrate an adaptation of an easily made machine devised and used by the writer for the past five years in sewage work.

The usual hitch in making an electrically driven floccer is the difficulty of making the operating speed slow and variable. Any speed desirable in flocculation is easily obtained with the illustrated machine by merely turning on more or less water to the aspirator. The automobile windshield wiper, if in good condition, is very powerful and will operate as many jar agitator paddles in a row as desired.

An ordinary automobile windshield wiper with vacuum supplied by a laboratory aspirator or suction pump is the motive power. The other materials needed are a few 3/16 inch brazing rods, some sheet brass or other metal, a few brass or copper washers, and several two quart fruit jars, preferably square. Round jars may be used on this machine, due to the oscillating motion of the paddles, if square jars are not available. The wood frame may be built from packing cases if nothing better is at hand.

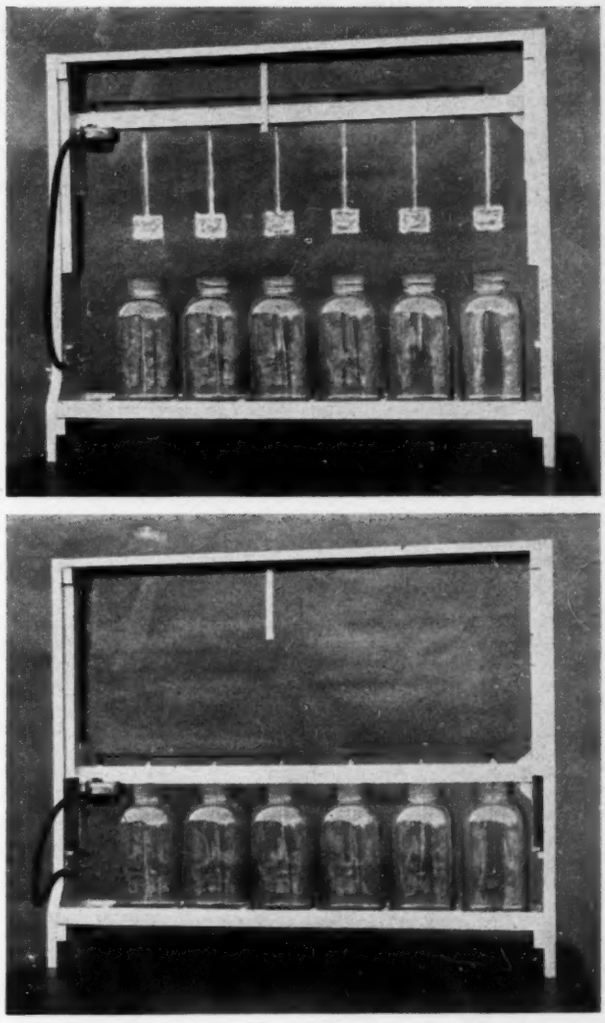
A crank, with about one inch off-set, is first made for the windshield wiper and fastened onto the shaft either with solder or a threaded collar depending onto the type of wiper used. The brass rod is cut into appropriate lengths to allow for bending a crank on one end with the same off-set as the driver; and to allow for the thickness of the wood cross piece with enough rod remaining to reach nearly to the bottom of the fruit jars when in flocculating position. The rod may be bent in a small vise with a hammer. The wood cross piece which acts as a bearing for the paddle shafts is about 1 by 1½ inches in cross section and the holes are drilled through the 1½ inch way. The holes should be a good fit for the paddle shafts but not tight. It is important that the holes be properly spaced and drilled vertical or there will be difficulty in lowering the paddles into the jars.

A washer is soldered onto each paddle shaft at each bend of the crank to act as support for the connecting rod and the paddle shaft respectively. The paddle shafts are then run through the bearing holes in the wood cross piece and another washer soldered to each snugly against and under the wood cross piece.

The connecting rod is made from a piece of ⅛ inch sheet brass ½ inch wide and of proper length for the desired number of jars. The holes are drilled on the same centers as those in the wood cross piece. It is not usually necessary to fasten the connecting rod in place as its own weight should keep it on the cranks of the stirring rods.

The paddle blades consist of one piece of 1/16 inch sheet brass about 1½ inches wide and of a length that will enter the mouth of the fruit jar. The blades are soldered to the paddle shafts. This completes the mechanical part.

*Bureau of Sewers and Sewage Treatment, Atlanta, Ga.



Laboratory Floccer. Motive Power Is Windshield Wiper Operated by Laboratory Suction Pump on Faucet. What Appears to Be a Rod Connecting the Stirring Rod Is a Flat Strip of Brass Drilled with Holes.

The wood frame is made to permit sliding the machine-head up (out of) or down into the jars. The jars are spaced properly on the base by tacking on thin strips of wood. The short piece of rubber hose makes a permanent connection from the windshield wiper to a piece of brass pipe across the side of the frame merely for convenience in attaching the aspirator hose at the back.

The strap hanging from the top of the frame is a piece of hack-saw blade heated and bent to form a spring catch for holding the machine head above the jars when not in operation.

There has been some comment to the effect that the oscillating motion may break some floc particles in the immediate vicinity of the blades. This is probably true; but there is no flocculator built, large or small, which does not have this same defect. The relative movement between the water and the paddle blades at their point of contact is necessarily great in order to keep the water in the more remote parts of the flocculating jars in a proper swirling motion. Overcoming this defect, inherent in all

flocculators, would require a much more expensive installation and the benefit to results would not be worth the difference in cost. It would be necessary to distribute a large paddle surface throughout the tank and move it at extremely slow speed.

However, there is nothing to be gained by the above argument one way or another. If you need a laboratory floccer and have no money to spend for speed reducers and an electric motor, one may be made with fifty cents worth of brass and a windshield wiper. If you do not have access to a supply of brass stock, a satisfactory machine may be made in an hour using pieces of tin can for paddle blades and stiff iron wire for paddle shafts and connecting rod. The slide and frame is a real convenience but not a necessity.

Water Works Projects Approved by PWA for Which No Funds Are as Yet Available*

(Total Estimated Costs Better Than 24 Million)

Location of Projects	Cost
Alabama—	
Sheffield	$297,000
Tuscumbia	198,000
Montgomery	30,300
Arizona—	
Tucson	503,636
Safford	394,545
Arkansas—	
Plumersville	25,455
California—	
Carpenteria	12,000
Calaveras Co.	219,000
Ventura	843,636
Antioch	87,272
Calif. State	6,800,000
Atwater	78,182
Colorado—	
Denver	900,000
Trinidad	30,000
Pagosa Spring	27,300
Florida—	
Sarasota	138,481
Orlando	617,142
Illinois—	
Rushville	72,727
Ava	41,818
White Hall	41,818
Elburn	27,272
Jacksonville	460,000
Iowa—	
Oelwein	470,000
Britt	27,272
Calamus	26,000
Maquoketa	40,800
Menlo	40,000
Fairfield	22,727
Cedar Rapids	143,636
Wayland	35,000
Kansas—	
White Cloud	31,000
White City	52,508
Strong	35,500
Lenexa	69,091
Norwich	37,000
Eudora	25,363
Melvern	43,636
Lorraine	29,221
Severy	66,300
Sylvia	38,658
Isabel	28,344
Le Roy	55,750
Vermillion	40,993
Kentucky—	
Madisonville	36,000
Louisiana—	
Rayne	165,950
Jennings	150,000
Delcambra	46,600
Dernice	49,000
Franklinton	99,000
Morningsport	35,000
Massachusetts—	
Framingham	60,000
Swansea	291,000
Winchardon	160,000
Norwell	300,000
Essex	163,000
Springfield	172,000
Somerville	87,000
Needham	86,200
Topsfield	65,000
W. Stackbridge	92,520
Dartmouth	140,000
Russell	30,000
Lowell	651,000
Leicester	43,000
Michigan—	
Ruthton	18,165
Missouri—	
Braymer	69,090
Fornfelt	49,091
Bethany	41,913
Montana—	
Three Forks	58,181
Malta	4,294
Nebraska—	
Campbell	10,000
Overton	15,455
Chadron	90,909
Madison	45,000
New Hampshire—	
Conway	40,000
Milford	26,278
New Mexico—	
Clayton	80,000
New York—	
Indian Lake	110,909
Mamaroneck	418,770
Angola	26,470
Grand Island	138,181
Ballston Springs	76,363
Little Valley	30,142
Clarkstown	550,000
Norfolk	181,818
Pittsford	21,918
Port Byran	100,000
Elma	60,621
Farnham	43,300
Evans Mills	60,000
Niagara Falls	237,653
Cortlandt	38,000
Bergen	23,636
North Carolina—	
Valdese	103,454
Ohio—	
Lucas Co.	69,600
Seaman	40,500
Oklahoma—	
Indinhoma	25,450
Enid	1,189,064
Catoosa	38,180
Kaw City	100,000
Osage	27,270
McAlester	191,000
Wagener	45,450
Langston	27,270
Strong City	5,454
Goltry	29,090
Chickasha	49,090
Buffalo	47,955
Pennsylvania—	
Semis Grove	50,000
South Carolina—	
Orangeburg	80,000
South Dakota—	
Vermilion	25,545
Lake Andes	17,273
Canton	20,000
Whitewood	27,272
Huron	60,000
Huron	30,909
Lennox	20,230
Parker	19,090
Morristown	9,090
Madison	26,650
Tennessee—	
Celina	41,000
Graysville	43,636
Texas—	
Rockport	125,000
San Diego	100,000
Sherman	90,000
Dallas	222,000
Tehuacane	16,000
Victoria	73,920
Utah—	
Ferron	25,450
Goshen	36,360
Hurricane	33,540
Morgan City	6,335
La Verkin	8,180
Meadow	7,270
Honeyville	22,000
Ogden	75,000
Richmond	22,727
Virginia—	
Winchester	532,000
La Crosse	38,180
Halifax	52,000
Washington—	
King Co.	687,000
King Co.	128,000
Dayton	34,545
Wisconsin—	
Oostburg	52,820
Waldo	22,000
Poynette	30,900
Wyoming—	
Cody	74,540
Porto Rico—	
Fajardo	136,360
Guayama	200,000
TOTAL	$24,340,157

*Elsewhere in this issue other States are covered in another listing.

Association Meetings Scheduled:

APRIL 17-18TH—BUTTE, MONT. (Hotel Finlen).
Montana Section, A. W. W. A. Secy. H. B. Foote, State Board of Health, Helena, Mont. (Water Works Operators' Short School, April 15-16th, same place.)

APRIL 21ST—HARTFORD, CONN.
New England Water Works Association. Secy. Frank J. Gifford, Room 613, Statler Bldg., Boston, Mass.

APRIL 23-24TH—BALTIMORE, MD. (Hotel Lord Baltimore).
Four States Section, A. W. W. A. Secy. C. H. Becker, R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

APRIL 27TH—HARTFORD, CONN. (Hotel Bond).
New England Sewage Works Association. (Spring Meeting.) Secy. F. W. Gilcreas, State Department of Health, New Scotland Avenue, Albany, N. Y. (N. E. W. W. A. Meeting follows on 28th, same place.)

APRIL 28TH—HARTFORD, CONN.
New England Water Works Association. Sec'y. Frank J. Gifford, Room 613, Statler Bldg., Boston, Mass. (New England Sewage Works Assn. meets 27th, same place.)

MAY 14-15TH—FREDERICK, MD. (Francis Scott Key Hotel).
Maryland-Delaware Water & Sewerage Association. (Annual Meeting.) Secy.-Treas. A. W. Blohm, 2411 North Charles St., Baltimore, Md.

MAY 14-15TH—ABERDEEN, WASH. (Hotel Morck).
Pacific Northwest Section, A. W. W. A. Secy. E. C. Willard, 720 Corbett Bldg., Portland, Ore.

MAY 21ST—CONCORD, N. H.
New England Water Works Association. Secy. Frank J. Gifford, Room 613, Statler Bldg., Boston, Mass.

JUNE 11-13TH—LONG BEACH, L. I. (Lido Beach Club).
New York State Sewage Works Association. (Spring Meeting.) Secy.-Treas. A. S. Bedell, State Department of Health, Albany, N. Y.

JUNE 8-12TH—LOS ANGELES, CALIF. (Biltmore Hotel).
American Water Works Association. (Annual Convention.) Secy. B. C. Little, 29 West 39th St., New York City, N. Y.

JUNE 22-24TH—STATE COLLEGE, PA.
Pennsylvania Water Works Operators Association. (Annual Conference.) Secy.-Treas. J. M. Glace, 20 South 22nd St., Harrisburg, Pa.

JUNE 24-26TH—STATE COLLEGE, PA.
Pennsylvania Sewage Works Association. (Annual Conference.) Secy. L. D. Matter, Kirby Health Center, Wilkes-Barre, Pa.

JULY 20-24TH—STILLWATER, OKLA.
Oklahoma Water and Sewage Conference. (Annual Conference.) Secy.-Treas. H. J. Darcy, State Sanitary Engineer, Oklahoma City, Okla.

EDITORIAL

Speakers Who Talk too Long

ELSEWHERE in this issue is printed the program of technical papers scheduled for presentation before the approaching convention of the American Water Works Association to be held in Los Angeles, June 8th-12th. Much time and thought has been given by the Program Committee in building the program and selection of speakers and discussors.

The appearance of this program brings to mind previous meetings of technical associations and societies at which well-planned programs have been marred because of the fact that some speakers have talked too long.

Those speakers who over-run the time allotted them on programs are frequently inconsiderate to an extent that something more than the polite repeated reminder from the presiding officer, that they are exceeding their time limit, is justified. With certain classes of speakers one might expect to find a disregard for efficient use of the time allotted them on programs. But, it is difficult to understand why technically trained men who are supposed to appreciate the value of efficiency and precision should so disregard both, when it comes to the operation of meetings.

It is not as though these speakers had not been notified, at the time of their assignment of subject and position on the program, as to the number of minutes allotted them for their presentation. Note the word "presentation"; there being no limits set as to the length of paper or discussion to be prepared by the speaker for submission to the association for printing in its official publication. It is entirely true that it is not always possible, and is likely improbable, that an author can do justice to his subject in a paper which can be read word by word, and tables and graphs exhibited and explained, in the period allotted him on a program which must be sufficiently inclusive to satisfy the varied interests of the many attending technical meetings. On the other hand, it *is* possible for the author-speaker to curtail his presentation by selecting more important portions of his paper which can assuredly be read within the time allotted. He can determine his normal speed of delivery by actual test before the meeting and select passages to be read accordingly. If preferable (and it frequently is) the author may prepare a separate condensed paper, based on the original manuscript, which can be presented within the time limits. Then, he should determine to stick to the manuscript and curtail side remarks and departures.

In order to make it possible for those attending meetings to make the most effective use of their time and select those papers which they may especially wish to hear in the various sessions (some being simultaneously under way), it has been found advantageous to follow the time schedule system in program building. Showing on the program the hour in which each speaker is to be heard, makes effective attendance an easy matter, provided the program is run off on the schedule set. When speakers talk too long the whole idea behind the scheduled program fails of purpose and the resultant inefficiency proves to be an injustice to members and guests. Furthermore, long-winded speakers exhibit an inexcusable disregard for fellow speakers sharing with him the program period. Also, as much can be said regarding the presiding officer whose duty it is to hold the program to the time scheduled as nearly as possible.

Several schemes have been tried by technical societies in an attempt to keep speakers to schedule. The older and frequently effective system has been the preliminary and the final warning from the presiding officer. More modern, and less personal, has been the use of time limit signals in the form of flashing electric lights or the adaptation of varicolored light bulbs to indicate the passing of time until the final red (stop) light flashes on. Still another is the system of having a man (monitor) stand up in the rear of the audience a few minutes before the allotted time is up—then again stand up at the expiration of the time and remain standing until the speaker closes.

Where these schemes have been tried they have been fairly effective on the whole. Especially so, if the presiding officer will early in the meeting establish a precedent by stopping the very first speaker who persists in his disregard of the signal.

The speaker who talks too long more often than not becomes boresome to his audience and frequently does himself an injustice. He at least is unfair to fellow speakers and inconsiderate of the presiding officer. Some method must be devised to stop him. If the more polite methods prove ineffective, the presiding officer, in doing his duty, has no alternative to the use of the "big-stick" at his elbow's reach.

Efficiency in the running through of scheduled programs is essential if meetings are to be run with the most effective fairness to all. Considerate speakers appreciate this—the other kind must be made to.

Administrator-Operator Relations

IT is not often that a city manager discusses the question of relations that should exist between the administrative head of a municipality and their plant operators. Still less frequent are such discussions put into writing and published. Therefore, what City Manager Ed. Shafter of Pontiac, Mich (pop. 25,000) had to say before the Michigan Sewage Works Association, and now in print in the proceedings of the Conference (Michigan Eng. Exptl. Sta. Bul. No. 64), is worthy of comment.

Right in the beginning, Mr. Shafter's language discloses an attitude when he states the relationship between manager and operator at Pontiac in the following words—"He (the operator) confers directly with the City Manager." Others might have said that "he *reports* directly to," rather than *"confers* directly with." It is this language which most probably reveals why the City Manager of Pontiac has such a good insight into the sewage treatment problem and high regard for his "conferee"—the Plant Operator.

Further on, Mr. Shafter says that it was to him quite essential that there be close contact between the manager and plant operators to develop a mutual understanding of the problems and of the requirements for successful operation of the plant. This, amongst other reasons, should be so to the end that appropriations recommended might be ample for proper plant maintenance and operation. Further on, he states that the plant operator's service to his community is a conscientious service which warrants proper recognition and granting of his needs.

EQUIPMENT NEWS AND LITERATURE REVIEW

Lubricated Plug Valves

Plug type valves are being increasingly and satisfactorily employed in sewage works construction. To many the well known plug valve, here illustrated is not new. To others it will be.

Nordstrom Lubricated Plug Valve

Nordstrom Lubricated Plug Valves, manufactured by the Merco - Nordstrom (subsidiary of the Pittsburgh Equitable Meter Company), are especially suited for lateral air lines, sludge lines, grit chamber drain lines, and pump suction and discharge lines handling sludge or gritty material. The patented "Sealdport" method of lubrication found on all Nordstrom Valves assures positive shut-off and elimination of sticking. The arrangement of lubricant grooves on the plug and body prevents the lubricant from being blown from the valve by the pressure in the line.

For descriptive literature on these lubricated plug valves, address—Pittsburgh Equitable Meter Company, 400 N. Lexington Ave., Pittsburgh, Pa.

▼

Remote Valve Control

To supplement automatic control systems, The Boxboro Co. has developed a new Remote Valve Control. If hand valves are not easily accessible, it is only natural that necessary adjustments will likely be neglected. Where these conditions exist, a Foxboro Remote Valve Control, mounted on a centrally-located panel, enables the operator to adjust manually the degree of opening of an out-of-the-way, inaccessible or distant valve without leaving his station.

A feature claimed for Foxboro's Remote Valve Control is the extreme precision of valve setting. It is easy to make a change in pressure on the diaphragm motor of the controlled valve as small as ¼-inch of water or less. Used in conjunction with a Stabilflo valve, the controlled flow can be changed by less than 1 percent. Due to its original unique design, there is no "pumping" or vibrating. Air pressure on the diaphragm is held exactly at the desired setting.

For descriptive bulletin address Foxboro Co., Foxboro, Mass.

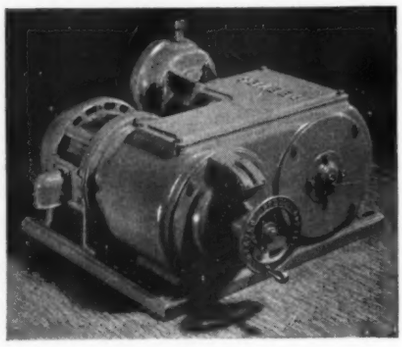
Foxboro New Remote Valve Control

▼

A New Reeves Motodrive

To meet the need for a variable speed drive which combines, in a compact and self-contained enclosure, any standard make of constant speed motor and variable speed control mechanism, Reeves Pulley Company, has developed the REEVES Vari-Speed Motodrive.

Any make of foot-type, constant speed



New Reeves Motor Drive

motor, within standard NEMA dimensions, may be used. Merely by turning a convenient handwheel, any desired speed within predetermined limits can be made smoothly and quickly available to insure maximum operating efficiency of the driven machine. A convenient dial indicator registers the speed.

The Motodrive combines features of both the well-known REEVES Variable Speed Transmission and Vari-Speed Motor Pulley. It utilizes the proved mechanical principle of a V-belt running between two sets of cone-faced discs which are adjustable in diameter and mounted on parallel shafts. A system of thorough ventilation maintains uniformly efficient temperatures of motor and variable speed mechanism. Another important feature is that the variable speed shaft may be extended on either side of the unit as required.

The drive is available in two designs—horizontal and vertical. Each design is built in four sizes which cover speed ratios from 2:1 through 6:1. Reduction units of helical gear type in rations up to and including 189:1 may be incorporated in the drive. In different combinations of sizes, ratios and reduction gears, output speeds ranging from a minimum of 1.35 R.P.M. to a maximum of 3480 R.P.M. may be obtained.

For complete information on the new Motodrive and descriptive literature address Reeves Pulley Company, Columbus, Indiana.

▼

Beckman pH Meter

The New Beckman pH Meter with glass electrodes is being offered by Arthur H. Thomas Company of Philadelphia. It is a readily portable, self contained and direct reading instrument designed for field, factory and laboratory use. The especially sturdy and easily cleaned glass electrode (requiring 2 ml. of solution only), is a feature. A vacuum tube amplifier does away with the galvanometer, thus eliminating interferences with reading accuracies (0.1 pH) over a range of pH 0 to

Beckman Glass Electrode pH Meter

pH 12.5. The pH Meter is rugged and not subject to vibrations; is entirely self contained in a walnut carrying case 11 x 9 x 8 inches. Closing the cover automatically shuts off the instrument and locks it. It sounds to be the best thing of its kind ever offered at a price as reasonable.

For further information address, Arthur H. Thomas Company, Philadelphia, Penna. *View Looking Down on Top Plate of*

▼

New Phase-Rotation Indicator

A new type of phase-rotation indicator, in which the outstanding innovation is the complete lack of moving parts, has been announced by the General Electric Company. Weighing only twelve ounces and having over-all dimensions of 5½ by 3½ by 3 inches, it can be carried around easily. This instrument will be found very useful in three-phase testing and installa-

G. E. Phase-Rotation Indicator

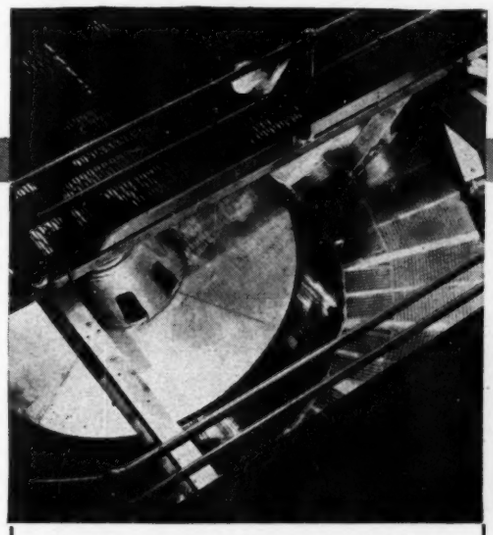
These 5 qualities of EVERDUR METAL

1 Highly corrosion-resistant
2 Strong as steel, permitting lightweight construction
3 Easily fabricated
4 Readily welded
5 Moderate in cost

explain its value for sewage service

ENGINEERS who have used this high-strength, copper-silicon alloy attest its value for many uses . . . including slide gates, weir plates, supporting bolts, baffle plates, screens and other metal parts exposed to corrosion.

Because of the five outstanding qualities of Everdur (listed above), this durable copper alloy has been chosen since 1927 for many sewage applications in different parts of the country. And, although these applications present a wide variety of conditions . . . Everdur has shown uniformly excellent resistance to corrosion and given every indication of permanence.



Here is an example of how Everdur Metal stands up under severe service. This mechanically cleaned fine screen, Bridgeport, Conn. plant, consists of Everdur plates with milled slots, fastened with Everdur screws. Everdur plates have been in service 5 years and are still in excellent condition. These screens are subjected to unusually severe service, inasmuch as they are not preceded by a grit chamber and dispose of highly varied industrial waste, domestic sewage and material from storm sewers.

•

EVERDUR METAL—"Everdur" is a registered trade-mark identifying products of The American Brass Company made from alloys of copper, silicon and other elements.

The first cost of Everdur is moderate and . . . due to its great strength and exceptional ability to resist corrosion . . . subsequent maintenance expense is almost negligible. This unusual metal is available in all commercial forms and can be readily fabricated by substantially the same procedures used with steel, including welding.

Engineers who have studied the performance of Everdur Metal in sewage treatment agree that it is the logical solution to a large number of corrosion problems. Additional information, including illustrations and data on typical installations, will be mailed free on request. 36833

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General Offices: Waterbury, Connecticut
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ANACONDA COPPER & BRASS

tion work, such as the testing and installation of three-phase meters and motors.

The new phase-rotation indicator employs two neon glow lamps and a simple circuit which requires no adjustment. Suitable terminals are provided for connection to 110-, 220,- or 440-volt circuits.

Operation is simple and sure. Pressing a centrally located button lights both of the glow lamps. The button is then released—and phase-rotation, clockwise or counterclockwise, is shown by which one of the lamps remains lighted.

For greater details, request literature of General Electric Co., Schenectady, N. Y.

Pittsburgh Meter Not Affected by Flood

The recent flood which demoralized Pittsburgh and crippled manufacturing activities for many firms, caused but slight inconvenience at the plant of the Pittsburgh Equitable Meter Company.

The factories, located in the high eastern residential section of the city were not touched by flood waters and only a short shut-down was made necessary while emergency equipment was secured to supply power.

During the height of the flood, the company gave twenty-four hour service to utilities in the stricken area while many employees served with the Red Cross for the duration of the emergency.

Kauffman Again Heads Link-Belt

Stockholders of Link-Belt Company recently elected as president of the company, Mr. Alfred Kauffman to succeed Mr. Geo. P. Torrence, resigned.

A. Kauffman

The new president started with Link-Belt Co. as a draftsman 35 years ago. He has served as sales engineer, designing engineer, superintendent of construction, plant manager. For the past four years he has served as vice-president and manager of the Chicago plant. He was president of the company from 1924 to 1932 and director since 1922. B. A. Gayman, of San Francisco, who is president of the Pacific Division of Link-Belt Co., was made a director at the same meeting.

Pacific Flush-Tank Elects New Officers

At the forty-third annual meeting of the Pacific Flush-Tank Company, held at their Chicago office, the following officers were elected for the ensuing year: Lester E. Rein, President; Harry E. Schlenz, Vice-President; D. M. Burwell, Treasurer; L. E. Langdon, Secretary.

The Eastern office at 441 Lexington Ave., New York, N. Y., continues under the management of Mr. Lionel L. Langford.

The Pacific Flush-Tank Company has, since its inception in 1893, concentrated continuously and exclusively on the design and manufacture of sewer and sewage treatment equipment.

CATALOGS AND TRADE LITERATURE RECEIVED

[Any of the publications reviewed in this column can be secured from or through Water Works & Sewerage, if such is preferable.]

"How to Handle IT":—is a uniquely arranged booklet which pictures in attractive style the various types of material handling and conveying equipment fabricated and installed by Chain Belt Co. of Milwaukee. Of interest to sanitary engineers and contractors are the REX-Belt Conveyors, Sludge Collector and clarifier Mechanisms, travelling trash Screens, Sludge Pumps.

A companion bulletion describes and illustrates the improved **"Rex Travelling Water Screens"** so extensively used in removing trash from intake water at pumping stations, power plants and the like. The four major illustrated improvements made in design insure a "leak proof" screen and elimination of unequal strain and wear on important parts. For these companion booklets ask for Bulletin No. 260 (the first) or Catalog No. 187 (the second). Address—Chain Belt Company, Sanitation Division, Milwaukee, Wisc.

"Ferrisul"—In a compact booklet from Merrimac Chemical Co. (Monsanto Chemical Co.) presents a treatise on "Ferrisul". The product is an anhydrous ferricsulphate employed as a coagulant for water, sewage and trade wastes. The booklet presents the properties and analysis of the coagulant and its adaptations, method of feed (solution or dry) solubility, corrosiveness and other useful information for operators and designers. For a copy address—Merrimac Chemical Company, Everett Station, Boston, Mass. or, Monsanto Chemical Company, St. Louis, Mo.

"Sodium Aluminate"—A companion booklet to "Ferrisul" is that which deals with Sodium Aluminate and its use in water treatment. The material is presented in very much the same manner as that pertaining to "Ferrisul." Both booklets may be had by a single request to the Merrimac Chemical Company of Boston, or, Monsanto Chemical Company of St. Louis, Mo.

"Liquid Chlorine"—A thirty-two-page (press fresh) illustrated brochure dealing with liquid chlorine is an excellent reference and data production just received from Pennsylvania Salt Manufacturing Co. It contains up to date and important "Facts About Liquid Chlorine," its handling and its use by approved methods. It relates troubles and methods of correction which will make it possible to employ chlorine to greater advantage, with less nuisance or danger. "Handling of Chlorine Containers" is an important chapter as are those on "Piping and Fixtures" and "Handling Leaks." The various applications of chlorine are briefly covered and methods of preparing hypochlorites are given. The final chapter comprises analytical methods for determining available and residual chlorine. This new brochure is a reference work. For a copy, address—Pennsylvania Salt Manufacturing Co., 1000 Widener Building, Philadelphia, Penna.

"Force-Feed Lubrication":—Is an enlightening and well illustrated booklet describing the unique Hills-McCanna Force Feed Lubricators which "won their spurs" some years ago, in the industrial fields, as the first successful automatic mechanical lubricators. For lubricating practically all types of equipment they feature the single plunger principle of force-feed, being ball valve equipped. May be located on pumps, engines, etc., or at a central point for oil distribution to various separated pieces of equipment. Another feature is the Metering Sight Feed attachment which insures accuracy without deficiency or waste of oil. Those who appreciate the highest grade lubricants will appreciate the precision lubricators described and illustrated, which insure *positive* but *not wasteful* use of high grade oils. For "Force-Feed Lubricators"—address, Hills-McCanna Company, 2357 Nelson St., Chicago, Ill.

"Turn Your Sludge Into Profits":—Is the cover title on a bulletin from the Royer Foundry and Machine Company which relates the possibilities of successful local marketing of prepared sewage sludge. The machine (Royer Disintegrator) which so effectively shreds dried or partly dried (56 pc. water) sludges, to produce a uniform easily handled humus fertilizer, is described and illustrated in six models and sizes. Successfully used at many plants, this efficient and readily portable machine, operators claim, "turns sludge into profits." For a copy of this new bulletin address—Royer Foundry and Machine Co., Kingston, Penna., or, C. G. Wigley (Sales Agent), 3108 Atlantic Ave., Atlantic City, N. J.

"Deep Well Pumps":—Worthington Deep Well Turbine Pumps of improved design are described in an easy to read folder which pictures the working parts of Type Q and QA pumps for heads up to 400 feet. These pumps have been especially designed to avoid falling efficiencies and overloading, due to water level fluctuations within the well. For Bulletin 450—B-19—"Deep Well Turbine Pumps"—address, Worthington Pump and Machinery Corp., Harrison, N. J.

"DIFCO Manual":—The fifth edition of the "Difco Manual of Dehydrated Culture Media and Reagents," now ready for distribution, gives the formulas and applications of the many prepared dehydrated culture media offered by Difco Laboratories, Inc. of Detroit. Water and sewage laboratory media prescribed by Standard Methods of Water Analysis (A.P.H.A. and A.W.W.A.) are given considerable space. A daily program for routine bacteriological work of the water and sewage laboratory is outlined and explained. For a copy of the Manual (its free)—address, Difco Laboratories, Inc., Detroit, Mich.

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With the Dresser Coupling, most of the work is done before field work begins. There is no field fabrication. The few, simple, *factory-made* parts are quickly and easily *assembled* on plain-end pipe by unskilled labor, above or in the ditch. Such *built-in* simplicity is not altered by the "human equation." The standard parts can go together in only one way—the permanently tight way! And only one type of tool is required—a wrench. Folder No. 355 tells you how to *simplify* your pipe-line work with Dresser Couplings—insuring permanent tightness, flexibility, strength, and *true* economy! Ask for it by number.

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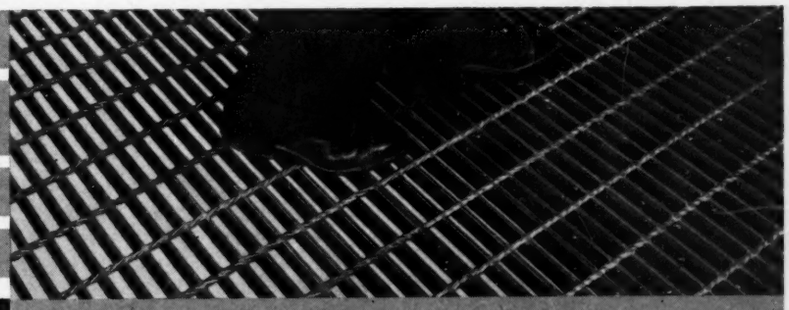
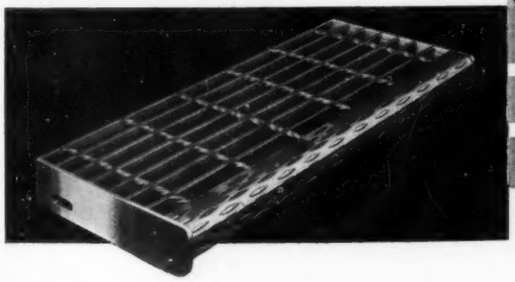
STEEL GRATING AND TREADS





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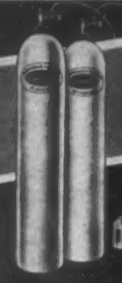

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EXPANSION JOINTS
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Sewage Plant Construction

Remember, when you are planning your new sewage plant, swimming pool or in fact any type of concrete structure, that the life of that structure depends on the joint filler you employ.

SERVICISED EXPANSION JOINTS are made to exacting specifications. Furnished in various types, such as Premoulded Asphalt, Cork Rubber, Sponge Rubber, Plain Cork, and many other types. They are made to prevent and control cracking of concrete, giving longer life to concrete construction however or wherever used.

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CAN WE HELP YOU?

On other pages in this issue you will find described new and improved equipment, etc., as well as reviews of recent trade literature received by us. By requesting the literaure described you will be able to keep your catalog file complete and up to date.

To our readers desiring additional help or information we will be glad to assist you in securing more complete information or data on any equipment or product you need. Use the convenient blank below — No cost or obligation.

WATER WORKS & SEWERAGE, 155 East 44th Street, New York, N. Y.
Gentlemen:—We are interested in the following items and would appreciate your assistance in securing more complete information.

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April

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Venturi Meters for Sewage and Sludge. Standard or Special Venturi Tubes; with or without Split Sections, and Automatic Vent Cleaners.

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Venturi Controllers for Raw Sewage and Return Sludge. Hydraulically or electrically operated to maintain any desired rate of flow.

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Kennison Nozzles for Sewage and Sludge. With Recording, Indicating, and Registering Instruments.

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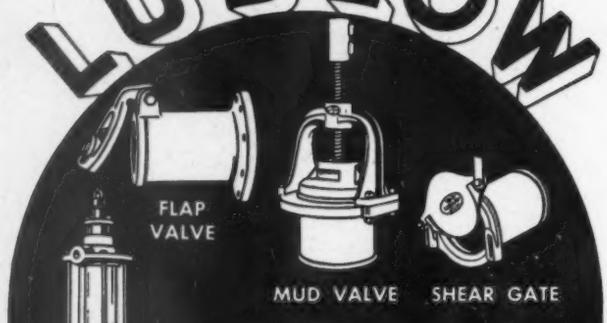

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Water Conditioning Equipment

"We'll Be Seeing You at the A.W.W.A. Meeting"

LOOKS like this year's A. W. W. A. Convention in Los Angeles, June 8-12, is going to hang up new records both for attendance and for program interest. We join the Convention Committee in urging you to attend, and we hope you'll drop by the Acipco Exhibit and see us.

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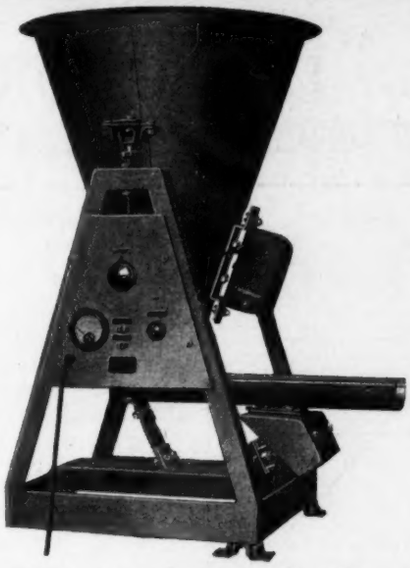

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SALES ENGINEER—Graduate Registered Professional Engineer, now employed, desires regular sales position with manufacturing concern specializing in machinery and equipment for construction of sewage disposal plants and kindred fields. 15 years in sales and sanitary experience in this work. Age 41; married; best of references, will go anywhere. Address H. T. C., % Water Works & Sewerage, 155 East 44th St., New York City.

OPERATOR OF PUMPS, powered by electric motor, gas engine or Diesel engine; also can take care of and read water meters. I am a married man and can give good references. Address R. A. M., Water Works & Sewerage, 400 W. Madison St., Chicago, Ill.

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SANITARY ENGINEER-CHEMIST: Graduate Sanitary Engineer (M. S. degree) with eight years' experience in water works and sewerage operation; and analysis of water and sewage. Wants operating position in water works or sewerage field; preferably in Southern states. Age 30, married and now employed. Address A. U., % WATER WORKS AND SEWERAGE, 155 East 44th St., N. Y. C.

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GRADUATE MECHANICAL ENGINEER: Two degrees. Thirty-one years of age, married. Seven years' experience in water works construction and management. Past two years as Supt. of Water Works in a city of 70,000. References as to character and ability furnished upon request. Available immediately. Address "R. P." Water Works and Sewerage, 155 East 44th Street, New York, N. Y.

SANITARY ENGINEER. Age 25. Married. M. S. to be received in June from U. of Illinois. Research Assistant in sewage research (garbage and sludge digestion) for the past two years. One year experience in State Highway Office making cost computations on Federal Aid work. Interested in any position in sanitary engineering. Location immaterial. "F. H. W." Water Works & Sewerage, 400 W. Madison St., Chicago, Ill.

SANITARY ENGINEER—Will receive M. S. in Sanitary Engineering, June, 1936. Engaged since March, 1934, as Research Assistant in Sewage Treatment at University of Illinois. Had responsible management of Sewage Testing Plant and Laboratory. Age 24, married. "B. J. L." Water Works & Sewerage, 400 W. Madison St., Chicago, Ill.

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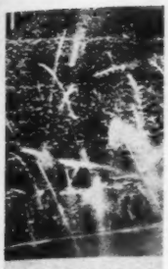

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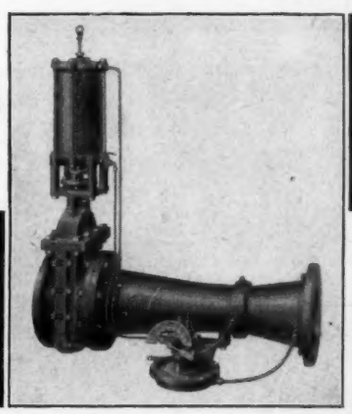

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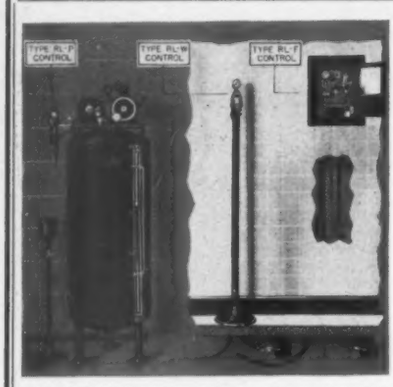

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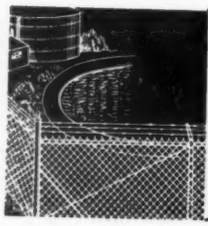

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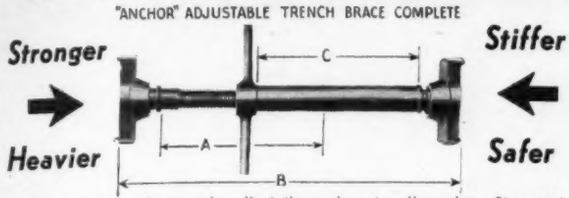

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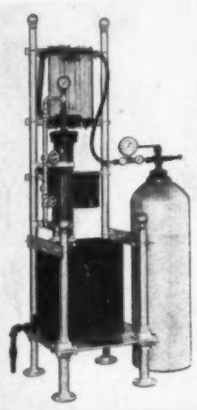

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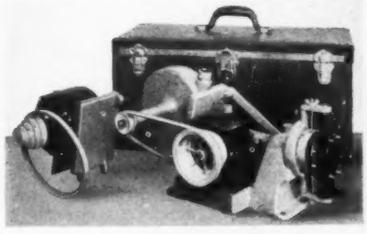

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Economics OF SLUDGE DISPOSAL BY DIGESTION...

SEPARATE SLUDGE DIGESTION is the cheapest and best justified element in sludge disposal practice—regardless of the treatment process preceding it or the capacity of the plant. Our convictions on this much-discussed matter of sludge disposal economics are set forth below.

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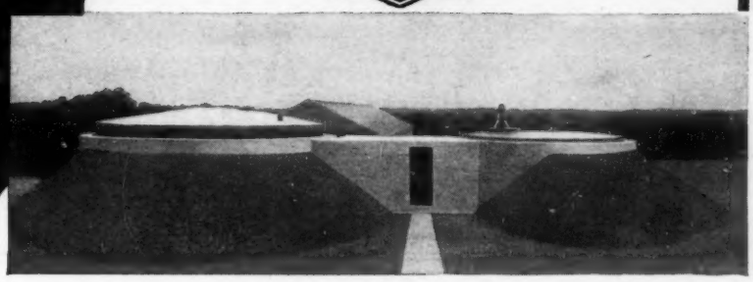

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Exception—*In activated sludge treatment the cheapest combination is vacuum filtration of the combined digested primary sludge with the undigested activated sludge.*

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Exception—*In activated sludge treatment, as noted before.*

MOST COSTLY BOTH TO BUILD AND OPERATE—

Disposal Methods, handling Raw, Un-digested Sludges

Plant Sizes:	*Plant Types:*
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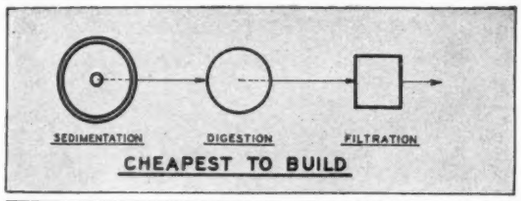
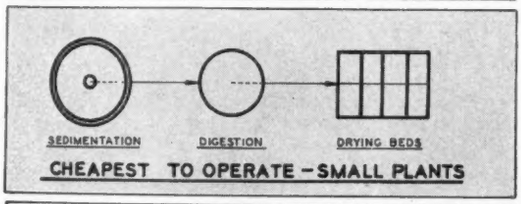
FUTURE TRENDS—

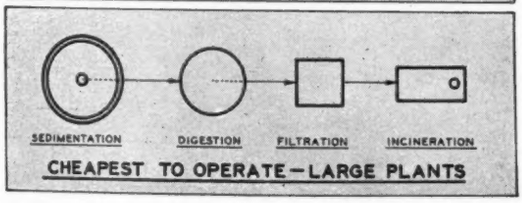
Digestion of Sludge in all cases, followed by Vacuum Filtration in smaller plants and by Vacuum Filtration and Incineration in larger ones.



CHEAPEST TO BUILD



CHEAPEST TO OPERATE—SMALL PLANTS



CHEAPEST TO OPERATE—LARGE PLANTS

The conclusions cited above were drawn from a detailed economic study* comparing the installed and operating costs of the various methods of sludge disposal being advanced today.

Comparisons were made for plants employing primary treatment alone or in combination with trickling filters, chemical precipitation and the activated sludge process. Costs were computed for capacities of 2, 5, 10, 25, 50 and 100 M.G.D.

Disposal methods evaluated consisted of digestion, open and covered drying beds, vacuum filtration and incineration—alone or in combination.

SEE OUR CONDENSED CATALOG IN MUNICIPAL INDEX

*We will gladly send you, on request, a reprint of this study, including 6 tables and 16 charts of cost comparisons.

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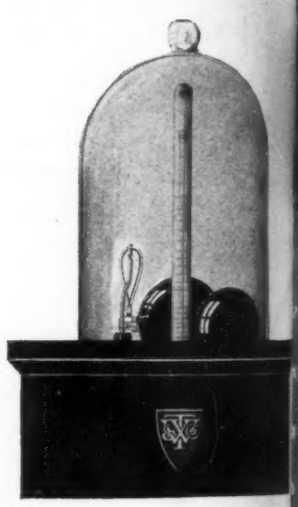

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